

Recurrent pneumococcal meningitis secondary to anterior base of skull defect and meningocele.

Taylor A¹, Van Der Meer G², Perry D², Best E^{2,3}, Webb R^{1,2,3}

1 KidzFirst, Middlemore Hospital, Auckland, New Zealand

2 Starship Children's Hospital, Auckland, New Zealand

3 University of Auckland, New Zealand

Background

In the current era of pneumococcal conjugate vaccine (PCV), approximately one third of children with a single episode of pneumococcal meningitis have an underlying anatomic defect or immunodeficiency¹.

Recurrent pneumococcal meningitis is defined as at least two episodes occurring more than three weeks apart².

Recurrences are very uncommon, and are estimated to account for only 1 - 2% of all pneumococcal meningitis episodes³.

Around 33% of children with recurrent bacterial meningitis have an intracranial defect with CSF leak⁴. These defects are commonly located in the anterior skull base or temporal bone and frequently include meningocele and cribriform plate dysplasia⁵.

S. pneumoniae is the most common pathogen in recurrent meningitis with underlying cranial defect (~83%)⁶.

We present three cases of recurrent pneumococcal meningitis in children where detailed neuro-imaging eventually revealed subtle anterior base of skull defects.

Case 1

A previously well 5-year-old boy presented with meningitis and a reduced level of consciousness (LOC). There was no history of recurrent ear infections, rhino/otorrhoea or significant head injury and he had received Pneumococcal Conjugate Vaccine (PCV) 7.

S. pneumoniae subtype 35 (cefotaxime MIC = 1mg/L) was isolated from blood cultures. Cerebro-spinal fluid (CSF) obtained after IV antibiotics was culture negative and showed a pleocytosis and positive pneumococcal PCR. He was admitted to the Paediatric Intensive Care Unit and required a temporary extra-ventricular drain for management of raised intracranial pressure. Neuro-imaging included CT head with contrast and MRI brain. Subdural enhancement was noted on MRI. No immunological investigations were performed. He received 14 days of vancomycin and cefotaxime and recovered fully.

Three years later, aged 8 years, he presented with another episode of bacterial meningitis. Blood cultures grew *S. pneumoniae* serotype 7c. CSF was culture negative but revealed positive Pneumococcal antigen and PCR. Immunological investigations and audiology were normal.

Imaging during recurrence:

- CT head with contrast. **Normal.**
- Fine slice bone re-formats of CT head. **Multiple small channels in the cribriform plate.**
- MRI brain and orbits. Confirms a small descending pit, lateral to the cribriform plate with abnormal enhancement: likely meningocele.

After Otorhinolaryngology (ORL) assessment he underwent endoscopic repair of meningocele and cribriform plate defect.

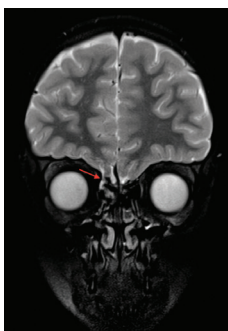


Fig 1. MRI brain case 1. T2 weighted coronal section, arrow demonstrates defect.

Case 2

A previously well 5-year-old girl presented with meningitis. She was born in 2005, prior to the inclusion of PCV on the New Zealand Immunisation Schedule.

Blood cultures were negative, CSF revealed gram positive cocci and pneumococcal PCR was positive. Immunological investigations were normal, audiology review found mild conductive hearing loss. She received 14 days of IV cefotaxime and recovered fully.

Seven years later, aged 12 years, she re-presented with bacterial meningitis. Detailed assessment revealed a history of chronic rhinorrhoea and a deep sacral dimple. Blood cultures grew *S. pneumoniae*, serotype 23B. CSF was culture negative but pneumococcal PCR and antigen tests were positive. Audiology was normal.

Imaging during recurrence:

- Non-contrast CT head. **Normal.**
- MRI brain and spine **Normal.**
- Non-contrast, fine slice CT base of skull with axial, coronal and sagittal reconstructions. Reviewed in ORL radiology conference where **anterior cranial fossa distortion (ACF)** with possible sagittal clefts were noted. **Possible bilateral meningoceles through the cribriform plate.**
- Fine slice helical CT through the maxillary sinuses and orbits confirmed **two defects in the floor of the ACF.**

She underwent endoscopic repair of bilateral meningoceles and anterior base of skull CSF leak.



Fig 2. Case 2 non-contrast fine slice CT head, coronal section. Arrow indicates cribriform plate defect.

Case 3

A previously well 4-year-old girl presented with meningitis. Her past history included a minor head injury and nasal bridge laceration age 2 years. Immunisations were up to date including 3 doses of PCV 10.

S. pneumoniae serotype 6C was isolated from blood and CSF cultures. She received 14 days of IV antibiotics with prompt recovery. Immunologic investigations and neuroimaging were not performed. Audiology revealed mild unilateral high frequency sensorineural hearing loss.

Her second meningitis episode occurred 8 months later. *S. pneumoniae*, serotype 33F was isolated from both blood and CSF. Immunological investigations were normal.

Imaging during recurrence:

- CT fine slice Petrous/Temporal bones/Skull base/Cribriform plate. **Normal.**
- MRI brain and spine given recurrence and discovery of sacral dimple.
- Small volume of fluid signal in the right olfactory recess? **meningocele.**
- Repeat fine slice CT sinuses. Subtle area of fluid density, likely meningocele, in right olfactory fossa. Small associated right cribriform plate defect.

After ORL review she underwent endoscopic repair of meningocele and cribriform plate defect.

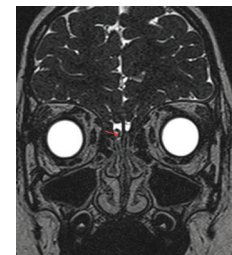


Fig 3. MRI Case 3. T2 weighted coronal section, arrow indicates defect.

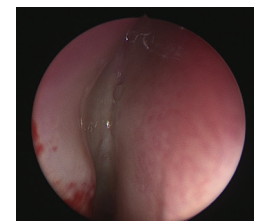


Fig 4. Case 3. Endoscopic image of right nostril during repair, looking up towards cribriform plate. Drop of clear CSF visible.

Summary and recommendations

These three cases of recurrent pneumococcal meningitis occurred in fully vaccinated, previously healthy children. Their underlying predisposition to bacterial meningitis was not apparent on initial presentation and was only revealed after detailed neuroimaging and ORL assessment during their second meningitis episode.

In the PCV era, investigations should be performed after a single episode of pneumococcal meningitis and should include³⁻⁵:

- **History** for rhinorrhoea/otorrhoea, head trauma, recurrent infection.
- **Audiology**
- **Examination** for rhinorrhoea/otorrhoea, midline abnormalities
- **Immunology:** FBC and film; Immunoglobulins; Complement pathways; HIV; Lymphocyte subsets; Consideration of abdominal ultrasound and vaccine response.
- **Neuroimaging**

Recurrent pneumococcal meningitis is rare and should prompt detailed investigation for underlying structural defects causing CSF leak.

Cranial defects may be subtle and require multiple imaging modalities to diagnose⁴.

- Retrospectively, each case in this series had subtle abnormalities visible on initial imaging.
- Cases should be reviewed with ORL specialists and a radiologist with expertise in head and neck imaging³. Re-formatting previous images may enable better visualisation of the skull base/temporal bones.
- The preferred imaging modality is fine slice CT base of skull/temporal bones/sinuses, with ≤ 1 mm sections in coronal, sagittal and axial planes^{3,6}.
- MRI base of skull may also be required to corroborate CT findings^{2,4}.

References

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