CASE REPORT

Community-acquired *Pseudomonas aeruginosa* meningitisCharles Gallaher,¹ James Norman,² Abhinav Singh,³ Frances Sanderson⁴¹Emergency Department, Chelsea and Westminster Hospital, London, UK²Infectious Diseases, Chelsea and Westminster Hospital, London, UK³Department of Radiology, Charing Cross Hospital, London, UK⁴Infectious Diseases, Charing Cross Hospital, London, UK**Correspondence to**

Dr Charles Gallaher, charlesgallaher@doctors.org.uk

Accepted 28 September 2017

SUMMARY

Gram-negative bacilli such as *Pseudomonas aeruginosa* are a rare cause of meningitis. Patients developing *P. aeruginosa* meningitis most commonly have a history of neurosurgical procedures. We report a patient who presented with community-acquired chronic meningitis secondary to *P. aeruginosa*, related to surgery for otosclerosis 5 years previously.

BACKGROUND

Chronic meningitis is defined as meningitis lasting for 4 weeks or more. Causes may be infectious or non-infectious. Onset is usually subacute, with symptoms including fever, headache and vomiting. Symptoms may remain static, fluctuate or gradually worsen, and the clinical course of chronic meningitis may vary widely from patient to patient.¹ Infectious causes of chronic meningitis include bacteria (e.g. tuberculosis, Lyme disease, syphilis), fungi (e.g. cryptococcosis, the most common cause of chronic meningitis in the Western hemisphere), parasites (e.g. toxoplasmosis) and viruses (e.g. HIV and enterovirus infection).²

Figure 1 MRI brain with contrast (T2 image) from day 2 of the patient's admission shows fluid in the left mastoid cavity (white arrow), representing postsurgical changes and a potential source of infection.

Figure 2 A T1 image from the same study shows abnormal enhancement of the right vestibulocochlear nerve (white arrow), correlates clinically with the patient's acute sensorineural right-sided hearing loss.

Pseudomonas aeruginosa is a Gram-negative bacillus and a rare cause of meningitis. In a recent case series lasting 18 years, 19 out of 21 patients who grew *P. aeruginosa* from cerebrospinal fluid (CSF) culture had previously undergone a neurosurgical procedure, and 7 had extraventricular devices in situ. Twelve patients had had *P. aeruginosa* isolated from another site previously.³

In a Spanish case series of 544 episodes of spontaneous bacterial meningitis, the associated organisms were Gram-negative bacilli in 7% of cases, of which the most common pathogens were *Escherichia coli* and *Pseudomonas* species. This study found advanced age, history of cancer, nosocomial acquisition of infection and urinary tract infection to be associated with Gram-negative bacilli meningitis (GNBM).⁴

There are case reports of *Pseudomonas* meningitis following spinal anaesthesia,⁵ and it is relatively common in uraemic haemodialysis patients.⁶ Rarely, *Pseudomonas* meningitis may complicate ear/skull base infections.⁷

CrossMark

To cite: Gallaher C, Norman J, Singh A, et al. *BMJ Case Rep* Published Online First: [please include Day Month Year]. doi:10.1136/bcr-2017-221839

Figure 3 MRI spine with contrast from day 3 of admission (T1 image) showing diffuse leptomeningeal enhancement of the brainstem (white arrow), cord and nerve roots, seen here as a bright line on the anterior aspect of cord, brainstem and visualised cisterns.

Patients with GNBm typically have a very severe clinical picture, and this is reflected in the condition's high mortality—it has the highest fatality rate of the bacterial meningitides at 53%.⁴

We present a young man with *Pseudomonas* meningitis, who had not had recent surgery and presented subacutely with a relatively mild illness.

CASE PRESENTATION

A 40-year-old Caucasian man presented to our hospital with headache and an acute confusional state. He gave a 5-month history of dry cough and lethargy, a 2-month history of weight loss (10 kg), and a 4-week to 6-week history of diffuse headaches which would develop over the course of the day, with associated vomiting, intense health anxiety, low mood and outbursts of anger.

Figure 4 MRI spine with contrast (T1 image) performed 19 weeks later demonstrates resolution of the leptomeningeal enhancement (white arrow).

Medical history included a left-sided stapedectomy for otosclerosis 5 years previously, complicated by localised granuloma formation postoperatively. This was treated with a labyrinthectomy and subtotal petrosectomy, leaving him with a left 'dead ear'. All of his surgery was extradural.

In 2013, he underwent surgery and radiotherapy for a left-sided pT2N1M0 testicular seminoma. Since treatment this malignancy has been in remission.

On examination, he exhibited neologisms and repetitive speech. The rest of the neurological examination was normal. There was no neck stiffness and no photophobia. Initial observations were within normal limits, but his temperature increased from 36.9°C on arrival to 39.9°C within 5 hours.

INVESTIGATIONS

Admission bloods (day 1) included white blood cell (WBC) count of $9.4 \times 10^9/L$ (reference range 4.2–10.6), neutrophils of 8.2 (reference range 2.0–7.1) and C-reactive protein (CRP) of 5.8 mg/L (reference range 0.0–5.0). Two sets of blood cultures were negative, as was an HIV antibody screen. Chest radiograph

Table 1 Results of serial LPs during the course of admission and as an outpatient

Day of LP Day 1=day of admission	Opening pressure cmH ₂ O	Appearance	Protein g/L	Glucose mmol/L	Serum glucose mmol/L	Lactate mmol/L	Cell count	Culture	Sensitivities	Notes and additional tests
1	29	Clear	0.74	<1.4	6.2	Not tested	WBC 423 100% mononuclear cells	Scanty <i>Pseudomonas aeruginosa</i>	Sensitive to cefazidime	Virology: herpes simplex virus, varicella zoster virus, enterovirus and mumps PCR-negative cerebrospinal fluid (CSF) lactate dehydrogenase (LDH) level: 139 IU/L—no reference range reported for CSF LDH but serum LDH 155–190 IU/L throughout with a reference range of 125–243
3	30	Turbid	Not tested	<1.4	7.9	7.3	WBC 1325 90% polymorphs 10% mononuclear cells	<i>Pseudomonas aeruginosa</i> Prolonged fungal culture negative	Sensitive to cefazidime	Mycobacterium: Auramine stain negative; no growth of acid fast bacilli seen within 6 weeks Mycology: cryptococcal antigen negative Cytology: densely cellular fluid; considerable number of neutrophils, a few lymphocytes and a few macrophages; no atypical cells Final diagnosis: acute inflammation; features consistent with meningitis Oligoclonal bands: CSF IgG was polyclonal but paired serum was not, suggesting local synthesis of IgG typical of demyelination but also seen in viral and bacterial antigens
5	33	Turbid	Not tested	<1.4	Not tested	Not tested	WBC 101 70% polymorphs 30% mononuclear cells	<i>Pseudomonas aeruginosa</i> (enrichment culture only)	Sensitive to cefazidime	Cytology: fluid contained several neutrophils, some macrophages and a few small lymphocytes Final diagnosis: acute inflammation; features in keeping with meningitis
10	Not tested	Clear	Not tested	3.2	Not tested	5.4	WBC 115 40% polymorphs 60% mononuclear cells	No growth	Nil	Nil additional tests
18	Not tested	Clear	1.18	1.6	Not tested	2.7	WBC 45 99% mononuclear cells	No growth	Nil	Nil additional tests
31	Not tested	Clear	0.80	2.0	4.2	1.8	WBC 26 99% mononuclear cells	<i>Staphylococcus hominis</i>	Nil reported	Coagulase-negative <i>Staphylococcus</i> deemed to be a contaminant rather than true indicator of intracranial infection (based on clinical presentation at the time)
59	Not tested	Clear	0.61	2.3	Not tested	1.7	WBC 11 90% polymorphs	No growth	Nil	Nil additional tests
87	Not tested	Clear	0.37	2.5	Not tested	1.4	WBC 11 Predominantly monocytes	No growth	Nil	Cytology: fluid contained a few, sparse erythrocytes; no nucleated cells present Final diagnosis: CSF, acellular sample

LP, lumbar puncture; WBC, white blood cell count.

on admission was normal. A CT of the brain, which had been performed the day prior to admission following an emergency department attendance, was normal apart from postsurgical changes in keeping with his previous ear, nose and throat (ENT) surgery.

DIFFERENTIAL DIAGNOSIS

A working differential diagnosis of bacterial meningitis/viral encephalitis was made, and treatment was started with intravenous ceftriaxone 2 g twice daily and intravenous aciclovir 10 mg/kg three times a day.

TREATMENT

When he underwent a lumbar puncture (LP) 8 hours post-admission, the opening pressure was 29 cmH₂O (reference range 10–20 cmH₂O). The CSF WBC was 423 cells/μL (100% mononuclear cells, reference range <5 WBC/μL), glucose level was <1.4 mmol/L with a paired serum glucose of 6.2, and protein was 0.74 g/L (reference range 0.15–0.45). Gram stain was negative.

Post-LP, the patient's headache improved, and by the following day his acute confusional state had resolved. However, the patient now complained of a significant deterioration in the hearing in his right ear, and headaches with 'whooshing' sounds. Otoscopy was normal, but audiological assessment detected a mixed sensorineural/conductive hearing impairment, thought to be due to a combination of pre-existing otosclerosis and sensorineural hearing loss secondary to meningitis. The patient was started on 40 mg of prednisolone for 7 days to mitigate further hearing loss.

OUTCOME AND FOLLOW-UP

On day 2, an MRI of the brain and whole spine with contrast showed significant leptomeningeal disease, particularly of the cervical spine, thought to be secondary to infection (as shown in figures 1–4). CT temporal bones showed changes in keeping with the patient's previous surgery.

On day 3, *P. aeruginosa* was isolated from CSF culture, sensitive to ceftazidime. A repeat LP was performed and intravenous ceftriaxone was switched to intravenous ceftazidime. The repeat LP showed an opening pressure of 30 cmH₂O with a turbid appearance, WBC of 1325 (90% polymorphs), glucose of <1.4 (serum 7.9), protein of 1.22 and lactate of 7.9 (reference range 1.0–2.9 mmol/L). Once again, Gram stain was negative but CSF culture grew *P. aeruginosa*.

Specialist cultures of the CSF, for fungi and mycobacteria, and viral PCR were ultimately negative. Cytological testing showed a densely cellular CSF containing a considerable number of neutrophils, a few lymphocytes and a few macrophages, with no atypical cells and no malignant cells.

The patient had a third LP on day 5 (after 2 days of ceftazidime therapy). Opening pressure was 33 cmH₂O, WBC 101 (70% polymorphs, 30% mononuclear cells) and CSF glucose <1.4. *P. aeruginosa* was grown from enrichment cultures only.

The patient continued to improve clinically and was discharged home after 11 days in hospital with a peripherally inserted central catheter in situ to continue self-administration of intravenous ceftazidime three times a day in the community, with follow-up by the Outpatient Parenteral Antibiotics Therapy (OPAT) team. In the OPAT clinic the patient reported a steady improvement in his symptoms to the point where, despite remaining on thrice-daily intravenous antibiotics, he was able to return to work.

Learning points

- ▶ *Pseudomonas* meningitis is commonly an acute severe infection and is often related to surgery.
- ▶ This case was unusual in that the patient was relatively well, presented with chronic meningitis and had had the relevant surgery 5 years before.
- ▶ This case highlights the importance of considering *Pseudomonas* as a pathogen when managing chronic meningitis.

Serial LPs, as an outpatient, showed a slow but steady improvement (table 1). On day 73 after admission he was converted from ceftazidime 2 g three times a day to meropenem 2 g three times a day as the WBC in his CSF had yet to normalise. He tolerated this change well with no reported side effects. A repeat LP on day 87 showed that the WBC had stabilised at 11, but the trend of normalisation in his CSF protein and glucose had continued and antibiotics were discontinued.

The patient remained well at 20 months after antibiotics were stopped.

DISCUSSION

Pseudomonas meningitis is commonly an acute, severe infection,^{4,8} and is often related to surgery.^{8,9} This case was unusual in that the patient was relatively well, presented with chronic meningitis and had had the relevant surgery 5 years before.

In the case of our patient, CSF sterility on therapy was confirmed at 10 days, and the patient was clinically 'back to normal' by week 3. Intravenous antibiotics were continued for 12 weeks, in view of the persistently raised CSF WBC count, the subacute presentation and the suspicion that the organism was also affecting devascularised tissues in the inner ear.

A surgical solution (e.g. drainage of the mastoid cavity) was discussed with the ENT surgeons who felt that in the absence of specific, correctable problems with the ear (the patient already had a left dead ear and was improving clinically with antibiotics), the best approach was to manage medically in the first instance and consider further surgery only if the problem recurred. Intrathecal antibiotics were considered but deemed not required due to the patient's good response to intravenous antibiotics.

This is an unusual case of low-grade infection with *Pseudomonas* meningitis appearing several years after middle ear surgery and highlights the importance of considering *Pseudomonas* as a pathogen when managing chronic meningitis.

Contributors CG reviewed the patient's notes, collated data, conducted a literature review, consulted with relevant experts and drafted the article. JN helped with the conception of the project, collation and analysis of the data, literature review, and redrafting of the article. AS reviewed all the patient's imaging. He helped interpret the imaging for the purposes of the case report. He helped select appropriate imaging slices for use in the case report, and advised on differential diagnosis of imaging findings where appropriate. FS was the consultant in charge of the patient. She was responsible for redrafting the case report.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

© BMJ Publishing Group Ltd (unless otherwise stated in the text of the article) 2017. All rights reserved. No commercial use is permitted unless otherwise expressly granted.

REFERENCES

- 1 Sexton DJ. Approach to the patient with chronic meningitis. 2015 <https://www.uptodate.com/contents/approach-to-the-patient-with-chronic-meningitis> (accessed 9 Jan 2017).
- 2 Greenlee JE, Wahlen GE. Subacute and chronic meningitis. 2015 <http://www.merckmanuals.com/professional/neurologic-disorders/meningitis/subacute-and-chronic-meningitis#false> (accessed 9 Jan 2017).
- 3 Pai S, Bedford L, Ruramayi R, *et al.* Pseudomonas aeruginosa meningitis/ventriculitis in a UK tertiary referral hospital. *QJM* 2016;109:85–9.
- 4 Pomar V, Benito N, López-Contreras J, *et al.* Spontaneous gram-negative bacillary meningitis in adult patients: characteristics and outcome. *BMC Infect Dis* 2013;13:451.
- 5 Corbett JJ, Rosenstein BJ. Pseudomonas meningitis related to spinal anesthesia. Report of three cases with a common source of infection. *Neurology* 1971;21:946–50.
- 6 Cheng BC, Chang WN, Lu CH, *et al.* Bacterial meningitis in hemodialyzed patients. *J Nephrol* 2004;17:236.
- 7 Severino M, Liyanage S, Novelli V, *et al.* Skull base osteomyelitis and potential cerebrovascular complications in children. *Pediatr Radiol* 2012;42:867–74.
- 8 Chuang YC, Chang WN, Lu CH, *et al.* Pseudomonas aeruginosa central nervous system infections: analysis of clinical features of 16 adult patients. *Zhonghua Yi Xue Za Zhi* 1999;62:300–7.
- 9 Huang CR, Lu CH, Chuang YC, *et al.* Adult pseudomonas aeruginosa meningitis: high incidence of underlying medical and/or postneurosurgical conditions and high mortality rate. *Jpn J Infect Dis* 2007;60:397–9.

Copyright 2017 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <http://group.bmj.com/group/rights-licensing/permissions>.
BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Become a Fellow of BMJ Case Reports today and you can:

- ▶ Submit as many cases as you like
- ▶ Enjoy fast sympathetic peer review and rapid publication of accepted articles
- ▶ Access all the published articles
- ▶ Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow