CASE REPORT

Escherichia coli positive infratentorial subdural empyema secondary to mastoiditis and underlying cholesteatomaOmar Mirza,¹ Vinay Varadarajan,² Amir Saam Youshani,³ David J Willatt²¹Department of ENT, Wrightington, Wigan and Leigh NHS Foundation Trust, Wigan, UK²Department of ENT, Salford Royal NHS Foundation Trust, Manchester, UK³Department of Neurosurgery, Salford Royal NHS Foundation Trust, Manchester, UK**Correspondence to**Omar Mirza,
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SUMMARY

Infratentorial subdural empyema is a neurosurgical emergency that is associated with an alarmingly high morbidity and mortality if appropriate management is delayed. It is an important differential to consider when confronted with a patient with a reduced Glasgow Coma Scale, focal neurology and symptoms of raised intracranial pressure in the presence of a head and neck infection. It is also important that the primary team managing these patients is aware of the many pathogens that may be involved, including *Escherichia coli*. Early recognition, prompt diagnosis, timely involvement of the appropriate multidisciplinary teams, including neurosurgery, otorhinolaryngology, radiology and microbiology should be sought, and urgent intervention are imperative in avoiding a fatal outcome. This article presents a case of *E coli*-positive infratentorial subdural empyema secondary to mastoiditis due to underlying cholesteatoma, and a review of the pertinent literature.

BACKGROUND

Infratentorial subdural empyema is a rare form of intracranial suppuration that is associated with significant morbidity and mortality, and as such is a neurosurgical emergency. Although subdural empyemas account for up to 40% of intracranial abscesses, posterior fossa infratentorial empyema is a relatively uncommon entity, and accounts for between 0.6% and 1.9% of all reported cases.¹² Cases usually arise from neglected otogenic causes and in most cases prompt surgical intervention is required. Common causative organisms include the *staphylococcus* and *streptococcus* groups, whereas *Escherichia coli* as the primary isolated pathogen has rarely been reported in adults.

This article presents a case of *E coli*-positive infratentorial subdural empyema secondary to mastoiditis due to underlying cholesteatoma, and a review of the pertinent literature.

CASE PRESENTATION

A 40-year-old man presented with acute headache, cerebellar ataxia and confusion. This was preceded by a 5-week history of generalised malaise, left-sided otalgia and offensive, purulent otorrhoea. There was no history of any hearing loss, tinnitus or vertigo. He was normally fit and well and had no other comorbidities including any otological history.

On examination he had fever and was disorientated, with a score of 14 on the Glasgow Coma Scale (GCS). Neurological function in his limbs was normal, but he did exhibit some left-sided cerebellar signs. His cranial nerves, including the facial nerve were intact. The left mastoid was firm but tender on palpation and a purulent discharge was noted from the left ear.

INVESTIGATIONS

An ear swab and blood cultures were sent for Gram stain, and his blood profile demonstrated elevated inflammatory markers. Empirical broad-spectrum antibiotic therapy was started.

CT of the brain was carried out in the first instance and showed a hypodense posterior cerebellar collection with extensive gas loculation and associated hydrocephalus consistent with a subdural empyema (figure 1). Opacification of the left mastoid air cells in keeping with mastoiditis was also noted (figure 2). Further MRI of the brain confirmed the presence of an extensive infratentorial subdural empyema covering the superior aspect of the cerebellar convexity and compressing the cerebellum inferiorly (figure 3). A flow void was also noted in the left sigmoid and transverse sinus, suggesting the possibility of a thrombosis.

Figure 1 Axial section contrast CT of the brain showing posterior cerebellar subdural empyema with extensive gas loculation and evidence of hydrocephalus.

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Figure 2 Axial section CT of the brain (bone window) demonstrating opacification of the left mastoid air cells.

TREATMENT

The neurosurgical team inserted a right frontal extraventricular drain and performed a posterior fossa decompression and evacuation of the supracerebellar infratentorial empyema.

Figure 3 (A and B) Coronal section MRI of the brain demonstrating extensive infratentorial subdural empyema covering the superior aspect of the cerebellar convexity and compressing the cerebellum inferiorly.

Following this the otorhinolaryngology team was able to examine the left ear, which revealed infected cholesteatoma in the attic region. A subsequent myringotomy was performed, middle ear mucopus released and a grommet inserted. A left cortical mastoidectomy was then performed which uncovered sclerotic bone with marked pus and infected cholesteatoma within the mastoid antrum, which was carefully removed. A decision was made not to perform a formal tympanomastoidectomy to remove all the cholesteatoma, but to defer this to a more planned elective procedure. Intraoperative samples were sent for microbiological and histological examination.

OUTCOME AND FOLLOW-UP

Postoperatively the patient made good progress and regained full consciousness 24 h after operative intervention. A repeat CT of the brain showed a marked reduction in the size of the subdural collections and as expected some residual left middle ear cholesteatoma. A CT cerebral venogram confirmed the presence of a left transverse sinus, sigmoid sinus and internal jugular vein thrombosis, but this was thought to be longstanding and therefore the patient was not anticoagulated. Histological examination confirmed the presence of mastoid cholesteatoma and microbiology culture of the cerebellar abscess pus, left mastoid pus and infected cholesteatoma grew *E coli*. Following discussion with the microbiology team a further 6-week course of intravenous antibiotics was administered. The patient made a full recovery and was discharged home with a planned follow-up in the outpatient department with repeat imaging in order to plan a formal tympanomastoidectomy.

DISCUSSION

Infratentorial subdural empyema is an uncommon, life-threatening intracranial suppuration. It constitutes only a small percentage of all reported intracranial empyema, and as such there are only a few case series and isolated case reports in the literature regarding these lesions.^{1–4} The majority of these published cases are, however, from developing countries where intracranial suppuration remains a relatively common disease entity due to the poor socioeconomic conditions that exist for large proportions of the population.

The majority of infratentorial subdural empyemas are as a result of neglected otogenic causes, as was the case in our patient, but other causes such as bacterial meningitis, paranasal sinus disease, head trauma or haematogenous dissemination of systemic infection have been implicated.^{5–7} Acute mastoiditis is especially implicated with posterior fossa empyema in the infratentorial location due to osseous destruction in the Trautmann triangle over the sigmoid sinus plate or in the posterior cortex of the petrous pyramid.⁸ Authors have also observed a greater tendency for infratentorial subdural empyema to occur among the male population (for unknown reasons), and a significant seasonal predilection for patients to present in the summer months.^{1,2}

Patients may present with clinical features as a result of increased intracranial pressure, disturbances of brain function and secondary to systemic sepsis, such as headache, vomiting, altered consciousness, meningism and fever. These may present as a prodrome, days or weeks prior to a diagnosis being made. Cerebellar signs and lower cranial nerve deficits are often absent.⁹ In some patients these initial symptoms may be non-specific, which may cause an initial diagnostic delay with a subsequent sudden deterioration later in the clinical course secondary to direct brainstem compression and associated supratentorial hydrocephalus.^{2,9,10} Owing to the anatomical

location of the lesion, patients with an infratentorial empyema may deteriorate much more rapidly, and have a shorter initial duration of symptoms as compared with patients with a supratentorial empyema.³ This is demonstrated further in the reported mortality rates of up to 57.1% in patients with infratentorial empyema, compared with 9% in patients with a supratentorial empyema.¹¹

CT imaging may be the most sensitive, accessible and cost-effective imaging modality initially available, and should be considered first line. However, failure to demonstrate infratentorial empyema with CT has been reported previously, a limitation attributed to partial volume averaging effects and scanning artefacts due to the complex posterior fossa osseous architecture.^{5 9} MRI with diffusion-weighted imaging (DWI) is the preferred imaging modality for detecting infratentorially located empyema, owing to its multiplanar capabilities, improved soft tissue imaging and the absence of scanning artefacts related to the osseous skull base.^{12 13}

Emergent neurosurgical drainage, achieved by decompressive occipital craniectomy, craniotomy or even burr hole, combined with the simultaneous management of the primary source of infection, and intravenous antibiotics are the mainstay of treatment.¹⁴ The aim of neurosurgical intervention is to decrease the toxic and inflammatory influences on the brain and its blood supply, diminish any mass effect from the subdural pus and obtain samples for microbiology culture and sensitivity.¹⁵ Cases where conservative management has been successfully deployed in patients with normal GCS, no focal neurological deficits and limited abscess collection on imaging have been reported in the literature. However, this carries with it the disadvantage of not knowing the infective microorganism, the requirement of a prolonged course of empirical antibiotics and the potential of a relapse if the initial treatment was successful.^{5 15}

Learning points

- Infratentorial subdural empyema is a neurosurgical emergency, with a high morbidity and mortality if appropriate management is delayed.
- Early involvement of the multidisciplinary team, including neurosurgery, otorhinolaryngology, radiology and microbiology should be sought.
- MRI is the imaging modality of choice and surgical decompression should be considered first line with an extended course of intravenous antibiotics. It is also important that the primary team managing these patients is aware of the many pathogens that may be involved, including *Escherichia coli*.
- Although uncommon, infratentorial subdural empyema is an important differential to consider when confronted with a patient with a reduced Glasgow Coma Scale, focal neurology and symptoms of raised intracranial pressure in the presence of a head and neck infection.
- Early recognition, prompt diagnosis, timely involvement of the appropriate teams and urgent intervention are imperative in avoiding a fatal outcome.

A multidisciplinary approach, with the involvement of the neurosurgery and otorhinolaryngology teams was adopted in the surgical management of our patient, and a posterior fossa decompression and subsequent myringotomy, grommet insertion and cortical mastoidectomy was successfully carried out with a favourable postoperative outcome.

In cases such as this, where the patient has a subdural empyema secondary to a mastoid cause, an examination of the ear with a concurrent cortical mastoidectomy should be performed. It is then the surgeons' prerogative to continue to a formal tympanomastoidectomy if they wish. Many surgeons advocate a primary cortical mastoidectomy followed by a more formal tympanomastoidectomy after the acute inflammation and infection has settled. The main reason being a reduction in bleeding once inflammation has settled, allowing safer visualisation for finer microscopic work and the safety of critical structures such as the facial nerve.

The causative agents of subdural empyema are representative of those found in otogenic and sinus infections. Enteric bacteria such as *E coli*, isolated as the primary pathogen are rare in the adult population, but cases have been reported in children.¹⁶ Initial broad-spectrum antibiotics should be administered, with subsequent therapy guided by culture results and input from microbiology colleagues.

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