The spread of odontogenic infection to involve the cerebral tissues (subdural empyema): A case report

Eleanor Bowden

Department of Oral and Maxillofacial Surgery, Leeds School of Dentistry, Faculty of Medicine and Health, University of Leeds, UK

Abstract

Intracranial involvement as a result of dental infection is a rare but serious complication. The incidence of dental decay and subsequent odontogenic infection is high in the population. A dental abscess may present to the general dental practice, general medical practitioner, or to the accident and emergency department. Prompt diagnosis and treatment are essential in addition to an awareness of the potential life-threatening sequela if management is delayed. This case report aims to highlight the subdural empyema as a complication of odontogenic infection and resultant treatment.

Keywords: Empyema, infection, odontogenic, sinusitis

Introduction

A subdural empyema is a collection of purulent matter (pus) located in the cranium between the dura and underlying arachnoid mater. An empyema can progress into a brain abscess, meningitis, sinus thrombosis or can rapidly expand to occupy a whole cerebral hemisphere if left untreated.

These foci can cause problems by exerting pressure on the brain as it increases in size and can induce inflammatory changes within the brain and the meninges.

The first reported case published in the literature was in 1886 by Ceci and Onetti (1889) in Geneva.

Further research followed in 1910 by Blegvad, his ideas suggested that the dissemination of infection was by direct extension into the cranial cavity, i.e., by bony erosion via the middle ear canal or by a thrombophlebitis effect from that of a chronic suppurative ear infection.

There is an understanding that most intracranial infection is associated with a spreading sinusitis, otitis media, trauma, and surgery or less commonly as a result of pulmonary infection via a bacteremia.

To date, there is limited evidence in the literature which has investigated odontogenic infection as the source for subdural empyema and brain abscess. This report highlights the case of a young female in the United Kingdom.

A penicillin allergic otherwise healthy 22-year-old female presented to the emergency department with a 7 day history of localized left sided facial swelling, progressing to generalized left sided headache, neck stiffness, lethargy, and nausea. The patient had a Glasgow coma scale of 15, was alert and orientated but was complaining of severe pain to the head.

On clinical examination, the patient had tachycardia at 136 bpm, was pyrexic at 40.8, blood pressure of 119/80, respiratory rate of 22 breaths per minute (NEWS 7).

The patient was referred to the oral and maxillofacial surgery team, and a number of investigations were carried out. The patient had a white cell count of 13.64 × 10^9/L, neutrophil count of 12.70 × 10^9/L. On examination, the left eye was closed and proptosed, and the left cheek was distended, firm and swollen. On eye examination, both pupils were equal and reactive to light and accommodation and visual acuity was unaffected.

Intraorally, the patient had generalized plaque and calculus deposits, a grossly decayed dentition and multiple retained roots with associated pathology in both upper and lower arches.

Computed tomography (CT) examination of the head with contrast showed left maxillary, frontal, sphenoid, and ethmoid sinus mucosal thickening consistent with that of acute pansinusitis. There was a small extra-conal convex fluid and gas collection subperiosteally adjacent to the left medial rectus muscle. This finding was consistent with a left orbital abscess, considered secondary to the left ethmoid sinusitis. A subdural empyema underlying the left frontal bone was also...
identified as a complication secondary to the extensive left sided pansinusitis.

Orthopantomogram examination showed multiple periapical radiolucencies consistent with infection around the apices of the LR6, LL6, LL7, UR5, UR6, UR7, UL4, UL5, UL6, and UL7 teeth (Figure 1). There was left maxillary antral opacification consistent with sinusitis present on the plain film. Diagnoses were of a left orbital cellulitis with left paranasal sinusitis and associated left-sided cervicofacial abscess from dentoalveolar infection (Figures 2-4).

The patient was treated by a multidisciplinary team comprising oral and maxillofacial surgeons, ENT surgeons, ophthalmology, and input from neurology.

The patient was immediately commenced on empirical IV antibiotics with metronidazole, vancomycin, and ciprofloxacin. The patient was taken to theatre under joint care by the maxillofacial and ENT surgical teams. She underwent extraction of all upper and lower retained roots and decayed teeth plus orbital decompression, drainage, and antral washout. The pus exudate was sent for culture and sensitivity. A repeat CT scan was carried out four days later which showed left orbital recollection of fluid and increase in size of the subdural empyema to 12 mm × 3 mm. The patient had a second procedure comprising functional endoscopic sinus surgery antral washout and orbital exploration and re-drainage under GA. Cultures of the pus collected revealed the growth of *streptococcus anginosus*, *staphylococcus aureus*, and *hemophilus influenza*.

The patient continued to stay in hospital for IV antibiotics, and on the advice from microbiology, the vancomycin antibiotic was changed to linezolid. The patient required a total of 6 weeks of antibiotic therapy via a peripherally inserted central catheter. Four weeks after initial admission to hospital a repeat CT scan of the head showed complete resolution of the subdural empyema (Figure 5). Further blood tests revealed neutropenia after prolonged antibiotic treatment, and the patient was found to have pancytopenia from linezolid therapy. No signs of recurrent infection were identified 1 month post-hospital discharge. Ophthalmology review showed left eye deviation identified as likely secondary to tethering or nerve damage from the decompression intervention, no loss of vision was reported. Further clinical examination did not suggest any neurological deficit as a result of the infection.

Despite being a largely preventable problem, tooth decay still affects large proportions of the population and left untreated; it can progress to involve the pulp. At this stage, necrotic material may be asymptomatic, however once bacteria have invaded the periapical tissues forcing infective matter into these areas, a dental abscess may develop. Dental abscesses are polymicrobial in nature, involving various facultative anaerobes, such as the viridans group streptococci and *Streptococcus anginosus* group. If left to spread into adjacent anatomical structures, an abscess can consequently lead to serious health problems. These include sinusitis, osteomyelitis, cellulitis and Ludwig’s angina, cavernous sinus thrombosis, septic shock, brain abscess, and empyema leading to significant morbidity and mortality for the individual.\(^7\)

Clayman *et al.* reported that odontogenic sinusitis accounts for 10% of all maxillary sinusitis cases.\(^8\) In this case report, the findings would be consistent with spread of infection from the left maxillary molar teeth as a direct extension into the left maxillary sinus which progressed to left orbital cellulitis.

Figure 1: Orthopantomogram examination showed periapical radiolucencies consistent with infection around multiple permanent teeth

Figure 2: Intracranial left subdural empyema measuring 12 mm × 3 mm

Figure 3: Left maxillary sinusitis - high density fluid filling left sinus
It has been reported in the literature that orbital complications of sinusitis and intracranial infection coexist in up to 45% of cases and so it is paramount that any special investigations include imaging of the cerebral tissues to diagnose this usually in the form of magnetic resonance imaging or CT imaging.\[9,10\]

Usually, large brain empyemas and abscesses require surgical intervention with evacuation or drainage plus prolonged intravenous antibacterial therapy.\[10\] In this case eradication of the primary infective source, lavage of the paranasal sinuses and antibiotics alone aided the resolution of the subdural empyema.

Once a diagnosis has been reached, empirical antibiotic treatment must be commenced. This should be high-dose, directed against common organisms with broad-spectrum activity. This may comprise a high dose penicillin in combination with metronidazole. Other recommendations may be of cephalosporin. Recommended empirical therapy is a third generation cephalosporin plus metronidazole which offers broad coverage and good cerebrospinal fluid and abscess penetration.

Early diagnosis and prompt management are essential in the treatment of orbital cellulitis and subdural empyema to improve prognosis. Clinicians must be vigilant to the potential for a decayed dentition to be the origin of infection.

This case report highlights the significance of dental infection, and how an entirely preventable disease process - dental caries, can have catastrophic effects on the health of an individual. It is paramount as health professionals to promote good oral hygiene and regular visits to the dentist to aid in prevention of dental sepsis. It is also vital to raise awareness to both medical and dental practitioners of the consequences of delayed presentation and the importance of prompt management to minimize complications.

References