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Case Report

STERILE SUBDURAL EMPYEMA SECONDARY TO A SUBMANDIBULAR ABSCESS: A CASE REPORT

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ABSTRACT

Introduction: Subdural empyema is a rare and serious condition characterized by pus accumulation in the space between the dura mater and arachnoid mater. Odontogenic infection is one rare cause. This case report describes sterile subdural empyema as a complication of a submandibular abscess.

Case Report: A 46-year-old man presented with loss of consciousness, seizures, fever, and swelling of the right lower jaw. Three months earlier, he had undergone extraction of his lower right tooth. Head CT showed a crescent-shaped hypodense lesion in the right parietotemporooccipital region and a hypodense lesion with peripheral enhancement in the submandibular area. Buccal incision and drainage and craniotomy were performed. Pus was found in the subdural space. Blood cultures and cultures from both drainage sites showed no microorganism growth. Meropenem and metronidazole were administered. The patient later died due to multiple organ dysfunction syndrome (MODS).

Discussion: Subdural empyema is an infectious condition caused by hematogenous spread, direct extension from surrounding tissues, or venous or lymphatic spread. Odontogenic infection is one rare cause. Mainstay treatment includes surgical intervention and antibiotic therapy. The infection is generally polymicrobial. Previous antibiotic administration or inappropriate culture media can result in negative cultures.

Conclusion: Subdural empyema can arise from odontogenic infection. Therefore, rapid and appropriate identification and treatment are essential to prevent intracranial complications and reduce mortality and morbidity.

Keywords: subdural empyema; odontogenic infection complications; intracranial infection

INTRODUCTION

Subdural empyema is a serious condition characterized by the accumulation of pus between the dura mater and the arachnoid mater of the brain. Patients typically present with nonspecific symptoms such as headaches, altered consciousness, focal neurological deficits, and seizures.[1] Subdural empyema is a rare phenomenon, but it can occur in cases of uncontrolled infection or delayed treatment.[2,3,4] Though uncommon, 0.7% of patients with subdural empyema attributed to poor dentition.[5]

Submandibular abscesses can form due to untreated dental infections.[6] Then the infection process continues to spread to the brain and form the subdural empyema.[7] Imaging techniques, such as computed tomography (CT) scans or magnetic resonance imaging (MRI), are essential for accurately diagnosing subdural empyema.[7]

The mortality rate for subdural empyema ranges from 3% to 10.8%. Additionally, this condition can lead to significant morbidity, with potential symptoms including hemiparesis and persistent seizures.[2,3] Prompt surgical intervention and rapid administration of antibiotics are crucial for improving outcomes. The broad-spectrum antibiotic is given as the first empirical antibiotic.[2] This causes some cases of subdural empyema to be sterile without isolation of pathogenic microorganisms that grow in culture.[3,4] From previous studies, the prevalence of sterile subdural empyema has increased since the development of antibiotics to 37%. The study also showed that sterile subdural empyema has a worse prognosis compared to positive streptococcal culture results.[3]

In this case report, we describe a rare incident in a patient with sterile subdural empyema from the untreated submandibular abscess. This case report will provide important insights into the diagnosis and interventions of subdural empyema.

CASE REPORT

A 42-year-old man came to the emergency department with a loss of consciousness for 12 hours. Three months earlier, the patient had his lower right tooth extracted. Since then, the patient began to feel pain and swelling in the lower right jaw which worsened and the pain spread from the lower right jaw to the head. While at home, the patient fainted, spoke incoherently, appeared sleepy, had difficulty waking up, and even experienced shortness of breath. He also experienced several movements in the form of twitching of the left side of the mouth and upward eye deviation, which lasted for 5 minutes and repeated 3 times in the area of the lip muscles.

From the physical examination,

Glasgow Coma Scale was E3M5V4, blood pressure: 118/68 mmHg, pulse rate: 130-135 x/minute, respiratory rate: 20-30 x/minute, oxygen saturation: 80-90%, and axillary temperature: 38-39 ° C. Swelling was observed in the patient's lower right jaw, but no active inflammatory process was detected in the oral cavity. From neurological examination there was no meningeal sign, normal cranial nerve and no lateralization. A contrast CT scan of the head revealed a crescent-shaped hypodense lesion with fluid density crossing the suture in the right parietotemporooccipital region. Additionally, there was a hypodense lesion with heterogeneous fluid components and an outer border, which spread after contrast was administered, found in the buccal region, masticator space, and right parapharyngeal space (Figure 1). Laboratory examination showed leukocytosis (17,500/mL), and hyperglycemia, (230 mg/dL) . No significant abnormalities were present in the other laboratory results.

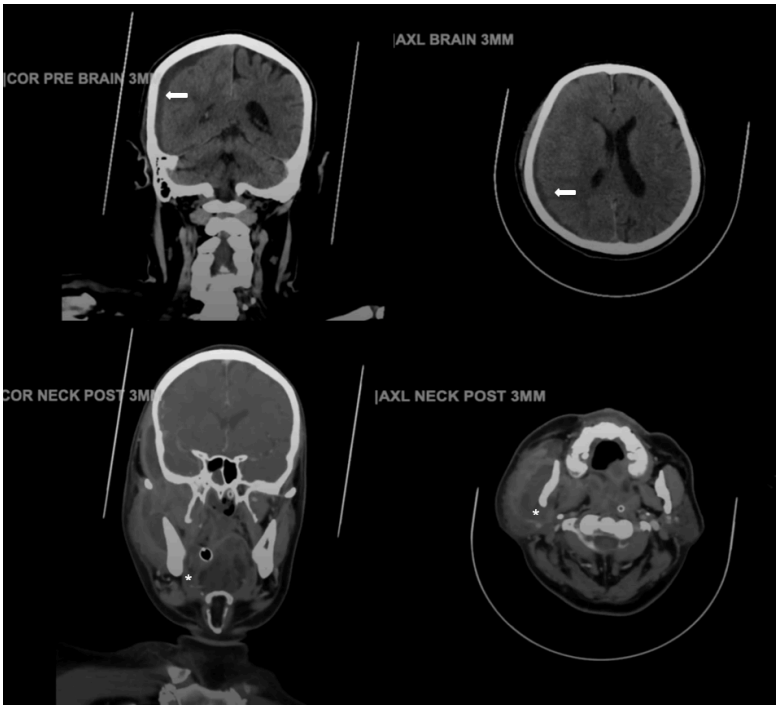

Figure 1. CT scan results of the patient's brain and neck while in the ER. The black arrow indicates a hypodense lesion in the right parietotemporooccipital region. The asterisk indicates a hypodense lesion with heterogeneous fluid components in the right buccal region, masticator space, and parapharyngeal space.

The initial diagnosis of the patient was decreased consciousness and status epilepticus due to meningoencephalitis, subdural empyema, and submandibular abscess. A drainage incision on the submandibular abscess was performed on the first day of treatment. Pus culture was taken from the submandibular abscess, but the results did not show any growth of microorganisms. For empyema abscess, conservative management was carried out with intravenous meropenem and metronidazole. On the fourth day, a CT scan evaluation was performed and it was decided to perform an evacuation craniotomy. A cloudy yellow fluid was obtained from the subdural layer and no growth of microorganisms was found on the culture. Additionally, the patient was also given mannitol, levetiracetam, and methylprednisolone. Then, an insulin drip was given because the patient experienced reactive hyperglycemia.

During treatment, the patient experienced status epilepticus again and was given levetiracetam and clonazepam with midazolam and dexmedetomidine. The patient's condition began to deteriorate on the 5th day of treatment when the patient started to experience stress ulcers and septic shock. The patient later died from multiple organ dysfunction syndrome (MODS).

Subdural empyema is a condition of pus collection between the dura and arachnoid membranes.[8] Subdural empyema is known to occur in various populations, with the highest prevalence in males in the second and third decades of life.[9] The subdural cavity has no boundaries so the collection of pus can extend rapidly. If the amount of pus is large, it can cause a compression effect on the surrounding structures and increased intracranial pressure.[10-12] Demographically, subdural empyema is strongly associated with otomastoid and sinonasal infections.[11] Other causes include trauma, neurosurgical procedures, and, most rarely, meningitis and intracranial abscesses. Smoking habits, diabetes, low socioeconomic conditions, and low education are the main risk factors.[13]

Meanwhile, odontogenic infections rarely spread intracranially and cause complications such as abscesses or meningitis. Although it

is a minor case, untreated odontogenic infection conditions can cause serious diseases such as subdural empyema.[7] Dental infections are known to cause about 3% to 10% of brain abscess cases. Dental infections or procedures can cause bacterial dissemination from the oral cavity. Periodontitis or caries involving molar teeth have the highest risk of developing into intracranial infections. Other risk factors such as immune system weakness, steroid treatment, alcohol, malnutrition, and smoking cause susceptibility.[14] However, in this case, there was no immunocompromised risk factor.

In this case report, two months prior, the patient experienced swelling after tooth extraction. Cariati et al. (2016) also reported a similar case, namely intracranial complications following tooth extraction.[7] Procedures such as tooth extraction, root canal therapy, and periodontal therapy are associated with the occurrence of intracranial abscesses, with tooth extraction being the most common cause. A study proposed criteria for odontogenic intracranial abscesses that must meet three points: no other sources of bacteremia were identified, the presence of oral bacterial microflora in the abscess, and clinical or radiographic signs of active disease in the teeth.[14]

Severe odontogenic infections can spread intracranially through four main routes. The most common are direct spread from adjacent tissue, especially from the jaw and teeth. Other routes are hematogenous spread, direct venous drainage spread, and lymphatic drainage spread. Microorganisms can spread to the subdural space through the valveless Breschet's vein. Infections from the maxillary posterior teeth are more likely to spread to the brain due to their close location to the maxillary sinus.[14] Infections can invade the central nervous system through continuity from the pterygomaxillary space and into the middle cranial fossa.[7] Intracranial infections on the same side as the odontogenic source show continuous spread. Meanwhile, intracranial infections on the opposite side or posterior part showed hematogenous spread.[14] In this study, abscesses were found in the buccal region, masticator space, and right parapharyngeal space with stinging in the ethmoid, maxillary, and sphenoid sinuses, especially on

the right side, and empyema was found in the right parietotemporooccipital region. There is the possibility of continuous direct spread from the jaw abscess location to the subdural space on the same side.

In subdural empyema, the infection is typically polymicrobial, involving organisms such as *Streptococcus spp*., *Staphylococcus spp*., gram-negative bacteria, and various anaerobic bacteria. Notably, the *Streptococcus milleri* group is commonly identified in empyema cultures.[4,15,16] A meta-analysis of 51 studies found that in cases of localized brain suppuration, 30% of cultures were negative, while 26% were polymicrobial. However, the actual frequency of polymicrobial infections may be higher, estimated to be around 50% of brain suppurative cases.[4,9] In cases associated with dental infections, the etiology typically comprises both aerobic and anaerobic bacteria, including *Streptococcus viridans* and *Bacteroides Sp*.[9] In this case, blood and aerobic pus cultures were conducted on the patient, but no bacterial growth was detected. Skeret et al. (2023) also reported culture results showing no growth of organisms in cases of subdural empyema. According to the literature, 7-53% of culture results in patients are generally negative.[8,15-18] Early administration of antibiotics or the improper use of media and culture techniques can lead to sterile empyema.[8,15] Moreover, culturing anaerobic bacteria poses additional challenges due to the need for proper specimen transportation due to the need for adequate specimen transportation.[19]

Until now, surgical intervention and empirical antibiotic management have been the mainstay therapy for subdural empyema.[20] Therapy should be determined based on the results of blood tests, surgical drainage, bacteriology examination, radiographic findings, and clinical response to therapy. Surgical management includes a burr hole procedure and/or craniotomy.[8] Empyema with a thickness of 2.5 mm can be managed with antibiotics without the need for surgery. Conservative measures can also be chosen in small empyema (<1.5 mm), but this option is rarely chosen.[8,9] Conservative therapy may be considered in patients with good clinical conditions and no midline shift on CT scans. However,

multimodal therapy has shown better results in reducing recurrence and preventing complications.[4,20] Surgical therapy is performed to evacuate pus, reduce intracranial pressure, and identify the causative bacteria. A craniotomy is generally preferred for better exploration, debridement, and complete evacuation of pus.[20] Craniotomy is also generally preferred because it shows better results with fewer recurrences.[8] Until now there are no standard guidelines regarding the optimal duration of antibiotics. The existing recommendations for antibiotic therapy for subdural empyema are given for at least 4-8 weeks.[9] At the time the diagnosis is determined, the patient needs to be given antimicrobial therapy with broad action for aerobic and anaerobic bacteria.[12,21,22] Therapy for suppurative brain infections generally uses a combination of vancomycin, metronidazole, and ceftriaxone, which generally have good blood-brain barrier penetration and antibiotic suitability for cases of dental infections.[9] Cefepime or ceftazidime can be given in cases of *Pseudomonas* infections.[8] Meropenem is also an antibiotic that is a broad-spectrum antibacterial and can penetrate the blood-brain barrier. Additionally, it has a good safety profile.[9] In this case, one possible cause of the aerobic culture of no bacterial growth may be due to the case of anaerobic bacteria that do not grow in culture. Arbune et al. (2018) found that meropenem therapy was ineffective as an empirical therapy for empyema, with the report that clinical improvement only occurred after empirical therapy was replaced with a combination of vancomycin, metronidazole, and ceftriaxone. Arbune et al. (2018) also obtained a negative bacteria culture and inferred that anaerobic bacteria most likely caused the empyema. This may be due to the cause of empyema being a dental problem. In dental cases, the etiology is generally a mixture of aerobic and anaerobic with a strong association with oral bacteria such as *Bacteroides Sp*., which typically have resistance to carbapenems like meropenem.[9]

The prognosis of subdural empyema depends on the level of consciousness at the time of initial arrival, the time of intervention, and the aggressiveness of patient management.[8] Pus in the subdural cavity can spread to the surrounding

tissue and accumulate into a potential space that can develop rapidly causing a mass effect on the surrounding tissue. Pus also causes a severe inflammatory reaction in the brain tissue, which can lead to edema. The inflammatory process that spreads to the leptomeninges also causes vasospasm and thrombosis. Hydrocephalus can also occur due to impaired absorption of cerebrospinal fluid. Increased intracranial pressure and expanding mass effects can lead to brain herniation. Other than that, the infectious process also causes an individual's systemic response.[12,22,23] The patient, in this case, came to the ER with severe clinical symptoms, even though multimodal therapy had been given comprehensively, the patient eventually died from multiple organ dysfunction syndrome (MODS). Global mortality of subdural empyema varies between 15% and 25%.[9] At the beginning of the course of the disease, morbidity and mortality reach 100%, while after proper diagnosis and rapid antibiotic management can reduce morbidity and mortality to 4-9%.[13]

CONCLUSION

Subdural empyema is a collection of pus in the subdural area with high mortality and morbidity. It can occur due to the spread of infection around the head including teeth. Therefore, early diagnosis, with comprehensive and multidisciplinary management is necessary for subdural empyema. Additionally, early preventive measures are important from the outset, with thorough management for odontogenic infections.

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