

## Subdural empyema secondary to odontogenic masticator space abscess: Detection by indium-111-labeled white cell scan

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### Abstract

Subdural empyema (SDE) is an extremely rare but serious complication of dental infection. A case is presented in which dental infection was complicated by a masticator space abscess and eventually led to a SDE. This report illustrates a rare sequence of events leading to SDE and its serendipitous detection by indium-111-labeled leucocyte scan. © 2001 Elsevier Science Inc. All rights reserved.

**Keywords:** Subdural empyema; Odontogenic; Dental infection; Leucocyte scan

### 1. Introduction

Subdural empyema (SDE) is a serious neurological condition associated with significant morbidity and mortality. It should be recognized early and treated as an emergency. Although SDE is a well-documented complication of dental sepsis, it is a remarkably rare occurrence [1,2]. Cranial CT, and more recently MRI, is the diagnostic modality of choice for detecting SDE [3]. We report a case of SDE secondary to a masticator space abscess that followed dental infection and root abscesses. The SDE was incidentally discovered on an indium-labeled white blood cell scan done for evaluating the jaw abscess.

### 2. Case report

A 25-year-old man presented with a 5-day history of pain in the right jaw area radiating to the head and neck. His past medical history was significant for rampant caries, multiple dental root abscesses, impacted wisdom teeth and extensive periodontal disease. About 20 days earlier, he had undergone extensive dental surgery on the right side involving extraction of seven teeth (including three impacted wisdom

teeth) and alveolotomy. Postoperatively, he had been treated with a course of oral antibiotics. About 2 weeks thereafter, 5 days before the current visit, he had presented to the emergency room (ER) with pain in the right jaw area for which he was started on oral penicillin. His pain persisted and he returned to the ER 2 days later. At that time he had swelling of the right jaw, face and neck region for which additional extraction of a right maxillary second molar and incision and drainage of a right masticator space abscess was performed the next-day. This yielded abundant necrotic, bloody material without much pus. Gram stains and cultures from the specimen showed normal oral flora and *Klebsiella pneumoniae*, which was felt to be an incidental colonizer. The penicillin was changed to cefadroxil. Nevertheless, he continued having right mandibular pain and headache and returned to the ER for his current visit.

On examination, he was pale, perspiring, febrile and tachypneic, with swelling in the right face and jaw area. Inflammation and pus were visible in the area of previous surgery in the right hemimandible. There was no neck stiffness and neurological examination was unremarkable. He was admitted and aerobic and anaerobic cultures were obtained from the right oral cavity and mandible region. The cephadroxil was replaced with intravenous clindamycin. A radiograph of the mandible was obtained at admission which did not show osteomyelitis. A CT of the brain, with and without contrast, obtained at the same time was also unremarkable. There was no significant improvement in his condition over the next 24 h and he had intermittent nausea

Abbreviations: SDE, subdural empyema

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and vomiting. The treatment regimen was then modified to intravenous ampicillin, gentamicin and metronidazole.

Mandibular osteomyelitis complicated by a masticator space abscess was clinically suspected. On the second

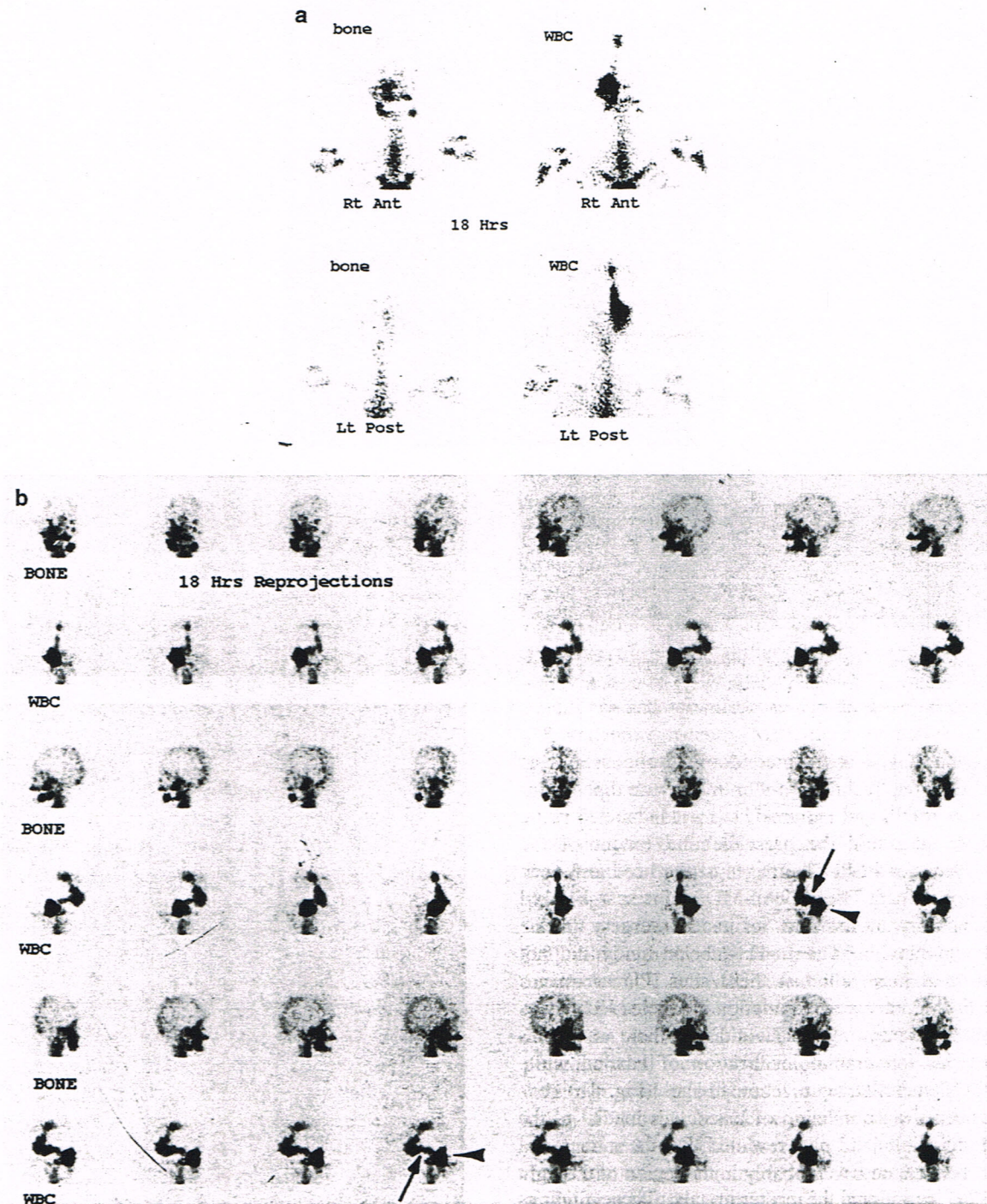


Fig. 1. (a) Anterior and posterior gamma camera images from Tc-99m-MDP bone scan (left two images) and In-111-labeled white cell scan (right two images). The anterior bone scan image shows mildly increased uptake in the mandible and maxilla from postoperative changes. The In-111 scan images show intense abnormal localization in the right upper neck and face region (arrowheads). The posterior image also shows abnormal intracranial band like activity in the midline. (b) 3-D reprojection images of the head and neck generated from SPECT data with the corresponding bone scan and leucocyte scan images displayed in alternate rows. These show an incremental rotation of the head and neck, starting from an anterior image (left lateral image is last image in rows 1 and 2, right lateral image is fifth image in rows 5 and 6). The In-111 images (even rows) show accumulation in the right upper neck just posterior to the maxilla and medial to the right hemimandible (arrowheads). The posterior intracranial localization is shown to be in the expected location of the right tentorial leaf (arrows), the torcula, and along the posterior interhemispheric falx. The corresponding bone scan images (odd rows), show some activity in the right maxilla and mandible from postoperative changes but do not show any intracranial uptake.



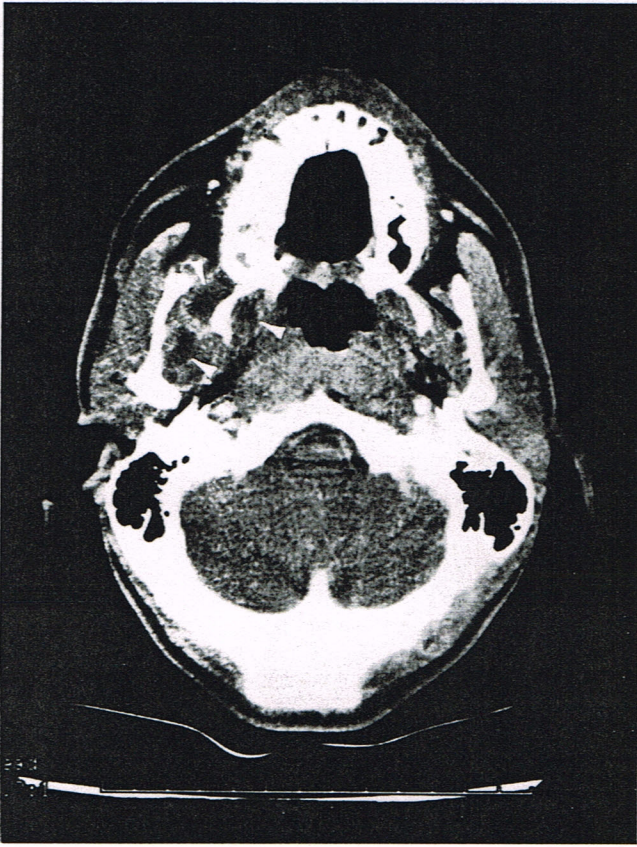


Fig. 2. Contrast enhanced axial CT image through the upper neck reveals ill-defined low-density areas within the right pterygoid muscles (arrowheads) with mild peripheral enhancement, consistent with abscess.

postadmission day, a combined dual-isotope scan was performed utilizing Technetium-99m methylene diphosphonate (Tc-99m MDP) and indium-111 (In-111)-labeled white blood cells, to assess the presence and extent of the infection. Planar and SPECT images of the head and neck region were obtained. The Tc-99m-MDP bone scan showed moderate activity at the sites of recent surgery in the mandible and maxilla. The In-111-labeled study did not show abnormal localization at these sites. Planar images (Fig. 1a) showed intense accumulation of labeled leucocytes in the right upper neck region. In addition, there was band-like posterior intracranial localization of labeled white cells. SPECT and 3-D reprojection images (Fig. 1b) confirmed abnormal accumulation of leucocytes medial to the right hemimandible, and also revealed that the intracranial band-like localization was probably in the region of the right tentorial leaf and along the posterior falx. These findings were suspicious for an abscess in the right pterygomaxillary region with associated intracranial empyema, likely to be in the subdural space. CT scans of the neck with intravenous contrast, done within a few hours of the nuclear scans,

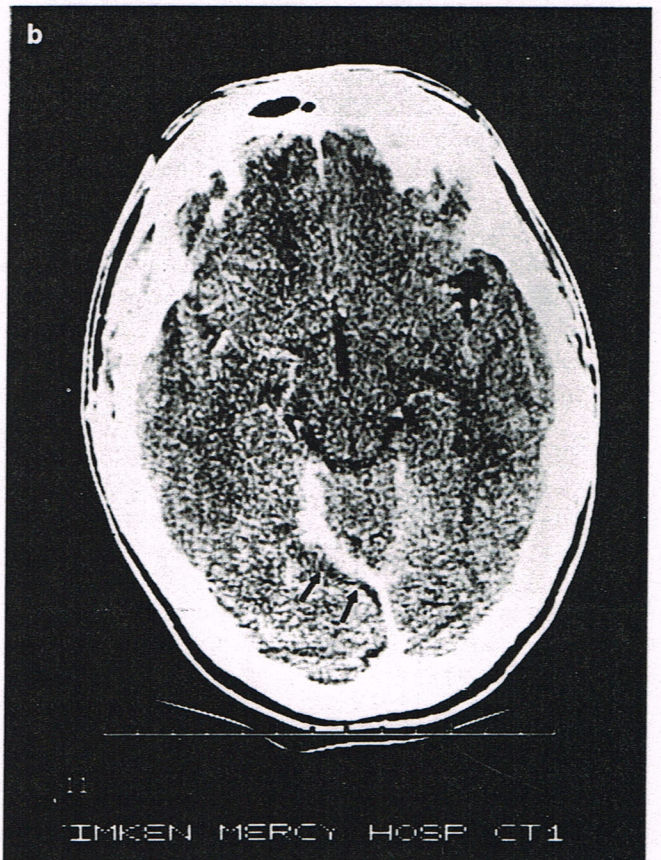
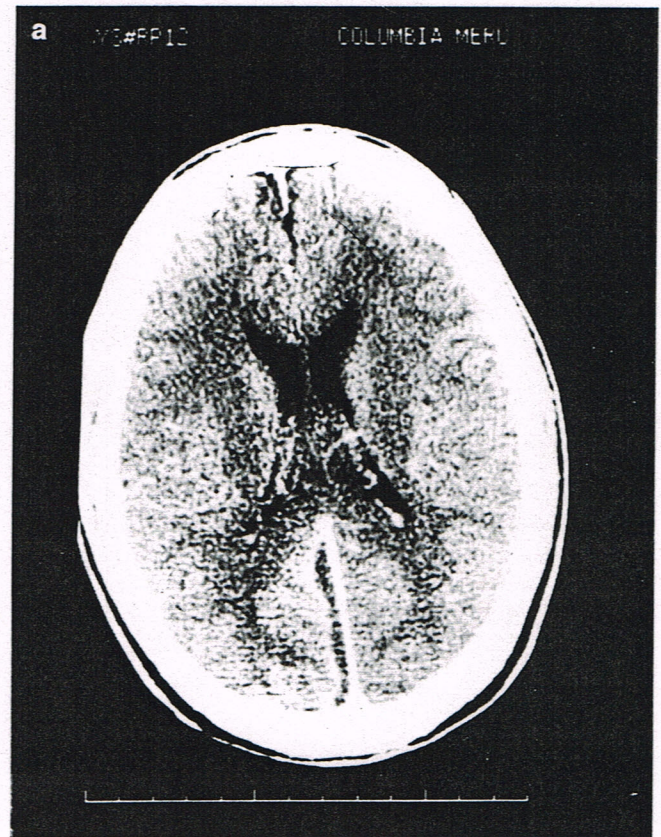


Fig. 3. (a,b) Axial contrast enhanced CT images of the brain show thin, low-density fluid collections with marginal enhancement, (a) along the posterior interhemispheric falx, and (b) along the right tentorial leaf (arrows).



showed a heterogeneous, peripherally enhancing, low density area in the right pterygoid musculature consistent with an abscess (Fig. 2). There was also some fluid in the right maxillary sinus. A contrast enhanced cranial CT, done at the same time, revealed a thin, lobulated, low-density fluid collection with marginal enhancement along the posterior falx on the right compatible with an interhemispheric SDE (Fig. 3a). There was also abnormal peripheral enhancement along the right side of the tentorium, with a thin adjacent subdural fluid collection, consistent with a suboccipital, supratentorial SDE (Fig. 3b). There was mild mass effect on the brain adjacent to the interhemispheric fluid collection without significant midline shift. No parenchymal abscess was evident. The patient was transferred to the intensive care unit pending a combined neurosurgical and otorhinolaryngological drainage procedure. The next morning, he noticed weakness in his left lower extremity with lack of motor response to commands, but preserved withdrawal from pain. A repeat CT scan of the head showed no significant change in findings from the previous day.

The patient was urgently taken to the operative room for drainage of subdural and pterygomaxillary abscesses. A right parieto-occipital craniotomy was performed. Foul-smelling pus was removed from the subdural space along the posterior falx and supratentorial region. Some membranes were seen in the subdural space and the underlying brain appeared edematous. Following drainage of intracranial SDE, the right pterygomaxillary space abscess was evacuated using a transantral approach and a standard Caldwell–Luc procedure. A moderate amount of foul-smelling pus was drained. Cultures from both abscesses grew microaerophilic *Streptococci*. A swab from the right maxillary sinus also grew *Enterobacter cloacae*. Based on these cultures, the treatment regimen was modified to intravenous penicillin and metronidazole.

On the second postoperative day, the patient experienced a Jacksonian seizure. There was no loss of consciousness and the seizure began as jerky movements in the left lower extremity before spreading to all four limbs. The seizures were controlled with diazepam and dilantin. A repeat CT at this time showed usual postoperative changes and no complicating features. His recovery thereafter was uneventful and there was steady improvement in his overall condition. His left lower extremity weakness also improved with physical therapy. On the twelfth postoperative day, he was discharged home in an ambulatory condition using a walker for assistance. Follow-up CT scans showed complete resolution of the subdural and pterygomaxillary inflammation and abscesses.

### 3. Discussion

SDEs account for 13–22% of all pyogenic intracranial processes [1,3,4]. In most published series, paranasal sinusitis was the most common cause of SDE, accounting for

56–77% of cases [1,5,6]. Other common causes are meningitis, otogenic infection and trauma, in that order [1]. Dental sepsis, arising spontaneously or after dental surgery, is a well-known but extremely rare source of intracranial infections, including subdural abscess [2,7]. In the largest published series of 699 cases of SDE, dental infection was the fifth most common cause accounting for only five cases (0.7%) [1].

Fever, seizures and motor deficits are some of the commonly encountered clinical features of SDE [1,3]. Seizures have been reported in as many as 50% of patients, while 25–50% of patients have neurological deficits that include contralateral hemiplegia and aphasia [1,4]. Our patient suffered left lower extremity monoparesis complicating his SDE. His solitary seizure episode on the second postoperative day was probably secondary to some post-surgical brain edema and resolved quickly with dilantin. Despite advances in imaging and treatment, SDE still carries significant morbidity, and the mortality rate in the post-CT era is still in the 8% to 18% range [1,8].

Before the advent of cross-sectional imaging, the diagnosis of SDE was mainly clinical, and its presence and location could be confirmed by arteriography, pneumoencephalography and cerebrospinal fluid studies [4]. In the pre-CT era, the role of radionuclide imaging was limited to brain scans utilizing Tc-99m-pertechnetate. These scans, which relied upon a breach in the blood–brain-barrier or the presence of leaky capillaries for localization, had only variable success in the diagnosis of SDE due to their limited sensitivity and specificity [3,9]. With the development of CT, and more recently MRI, these modalities have completely replaced the older methods for detection of intracranial infections.

In-111-labeled white cell scans rely on the accumulation of leucocytes at the site of acute infection, which can be then detected by imaging. These scans have shown remarkably high sensitivity and specificity for the detection of a variety of acute infections in different regions of the body [10]. Although the superior resolution, anatomic detail and accuracy of CT and MRI essentially preclude a primary role for In-labeled imaging in the diagnosis of SDE, the latter study can sometimes fortuitously demonstrate an unsuspected, critical focus of infection. In our patient, the hitherto unknown subdural abscess was serendipitously detected on an In-111-labeled leucocyte scan while evaluating for the presence and extent of abscess in his jaw region. We could find only one previous report where labeled leucocyte scanning was used to confirm an intracranial SDE [11], in which case only planar imaging was utilized.

CT is usually diagnostic but can occasionally be equivocal or false-negative in the early stages of SDE [5,6]. Nowadays, MRI has been shown to be superior to CT in demonstrating the presence, extent and nature of a subdural fluid collection [3]. It is more sensitive than CT for detecting small fluid collections due to the absence of artifact from the skull and multiplanar imaging capability. The majority



of subdural pus collections are located over the cerebral convexities (76–79%), with the interhemispheric fissure being the next most frequent location (12–21%) [1,4]. Only about 2.6% of SDEs are tentorial. SDE is bilateral in about one-fourth of cases [4]. In our patient, a contrast enhanced CT of the brain, obtained on the same day as the radio-nuclide scan, confirmed the presence of a SDE. It showed thin lentiform fluid collections with enhancing margins along the right margin of the posterior falx and along a thick, enhancing right tentorium, which correlated with the areas of increased uptake on the In-111 scan.

Intracranial extension of infection from the head and neck region can occur by two primary means. Direct extension by erosion through the skull occurs with sinusitis or mastoiditis. Indirect spread, which is a more common route, occurs by retrograde thrombophlebitis via the valveless veins of the basal venous system which connect the intracranial and extracranial spaces [1,5]. Most masticator space infections result from osteomyelitis of the mandible caused by uncontrolled dental infection. The organisms responsible for the SDE usually reflect the primary source of infection. Since sinusitis is the most common predisposing factor, the predominance of anaerobes is evident. In most reported series, *Staphylococcus aureus*, both anaerobic and aerobic streptococci, and other anaerobes were the organisms most frequently isolated [1,3,6]. Microaerophilic streptococcus and enterobacter species encountered in our patient have also been isolated from subdural infections by other authors [1,9].

In conclusion, there remains high morbidity and mortality associated with SDE. Early diagnosis and treatment improve the outcome. Our patient presented with the classic

clinical features of this condition that developed as a complication of fulminant dental infection. The unusual sequence of events in the progression of infection was: dental root infection leading to masticator space abscess and eventually to SDE. Even though CT or MRI is considered to be the diagnostic modality of choice, our case demonstrates the rare, fortuitous detection of SDE on an In-111-labeled white blood cell scan.

## References

- [1] Nathoo N, Nadvi SS, van Dellen JR, Gouws E. Intracranial subdural empyemas in the era of computed tomography. A review of 699 cases. *Neurosurgery* 1999;44:529–35.
- [2] Sprott MS, Newman PK, Hall K, Welbury RR, Ingham HR. Subdural abscess secondary to covert dental sepsis. *Postgrad Med J* 1981;57: 649–51.
- [3] Brennan MR. Subdural empyema. *Am Fam Physician* 1995;51: 157–62.
- [4] Galbraith JG, Barr VW. Epidural abscess and subdural empyema. *Adv Neurol* 1974;6:257–67.
- [5] Wackym PA, Canalis RF, Feuerman T. Subdural empyema of otorhinological origin. *J Laryngol Otol* 1990;104:118–22.
- [6] Dill SR, Cobbs CG, McDonald CK. Subdural empyema: analysis of 32 cases and review. *Clin Infect Dis* 1995;20:372–86.
- [7] Hollin SA, Hayashi H, Gross SW. Intracranial abscesses of odontogenic origin. *Oral Surg Oral Med Oral Pathol* 1967;23:277–93.
- [8] Bannister G, Williams B, Smith S. Treatment of subdural empyema. *J Neurosurg* 1981;55:82–8.
- [9] Farmer TW, Wise GR. Subdural empyema in infants, children and adults. *Neurology* 1973;23:254–61.
- [10] Goodwin DA. Clinical use of In-111 leukocyte imaging. *Clin Nucl Med* 1983;8:36–8.
- [11] McKillop JH, Holtzman DS, McDougall IR. Detection of subdural empyema with radionuclides. *Clin Nucl Med* 1980;6:263–7.