

## Case Report

# Is Computerized Tomography Sufficient for the Diagnosis of Brain Abscess?

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Brain Abscess (BA) is a focal suppurative process in the brain parenchyma. It is seen rarely in the Western population, with approximately 1500-2500 cases per year. They arise after the direct extension of infection from neighboring structures, hematogenous seeding of infectious agents, or trauma and neurosurgical complications. Symptoms of BA are non-specific and laboratory tests add little to the diagnosis. They develop in four stages and imaging characteristics of BAs differ according to the stage. The most important prognostic factor for BAs is the initial neurologic grade and diagnostic delay is a key contributing factor to the severity and outcome of BAs. This fact makes the timely diagnosis of BA in the Emergency Department (ED) very important. Here, we describe the case of a 20-year-old male who presented to ED with confusion, drowsiness and hypoacusis. While cranial computerized tomography reveals only localized brain edema, magnetic resonance imaging revealed the abscess with a fluid-fluid level and the patient was diagnosed as having a BA.

The changing imaging characteristics of BAs make their diagnosis difficult. Timely diagnosis of BA is very important in ED. In selected patients, further imaging modalities such as magnetic resonance help to make the diagnosis properly.

**Keywords:** Brain abscess, Emergency, Computerized tomography**Abbreviations**

BA: Brain Abscess; ED: Emergency Department; CCT: Cranial Computed Tomography; CMRI: Cranial Magnetic Resonance Imaging; DW-MRI: Diffusion-Weighted Magnetic Resonance Imaging.

**Introduction**

Brain Abscess (BA) is a focal suppurative process in the brain parenchyma and patterns in the diagnostic imaging considerably change depending on the onset of the disease process. Here, we describe the case of a 20-year-old male who presented to the Emergency Department (ED) with brain edema in Cranial Computed Tomography (CCT), but diagnosed as BA containing a fluid-fluid level in Cranial Magnetic Resonance Imaging (CMRI) and Diffusion-Weighted Magnetic Resonance Imaging (DW-MRI) due to early presentation of the patient.

**Case Report**

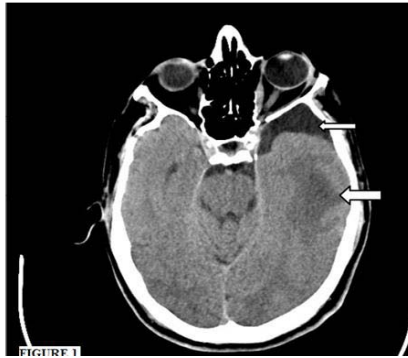
A 20-year-old male patient presented to ED with confusion, drowsiness and hypoacusis. On admission, his Glasgow coma scale was 12 (E3M5V4). On his right extremities, muscle strengths were 4/5. His blood pressure was 120/80 mmHg, heart rate 108 and he had a fever of 38.5°C. His history revealed that, a week ago, he had seen an otolaryngologist because of the pain in his left ear and was prescribed amoxicillin clavulanate. He had had a fever for four days.

In laboratory tests, the leucocyte count was 13000/mm<sup>3</sup> (4500-10000) with 86% neutrophils, biochemistry was normal and C

reactive protein level was 36 mg/L (<4.9 mg/L). A non-contrast CCT revealed a low attenuated and indefinite bordered area causing sulcal effacement in the left temporal lobe (Figure 1). Then, CMRI and DW-MRI were ordered. On the CMRI and DW-MRI, a 14mm diameter cystic lesion with a fluid-fluid level and rounded with cerebral edema causing sulcal effacement was diagnosed (Figures 2,3). Both CCT and CMRI showed inflammatory process in the left mastoid sinus (Figure 4). Ceftriaxone and metronidazole were administered intravenously as empirical antibiotherapy and neurosurgery and otolaryngology consultation were ordered. He was admitted to the surgical intensive care unit and a mastoidectomy was planned.

**Discussion**

The incidence of BAs in the Western population is approximately 1500-2500 cases per year and it is higher in developing countries [1]. The male-to-female ratio varies from 1.3:1 to 3.0:1 [2-5]. Since the mid 1970s, mortality from BAs has decreased [4,6,7]. This reduction has largely been attributed to the start of the computerized tomography era in 1974 and advances in antibiotic therapy [6,8,9]. A BA arises after the direct extension of infection from neighboring structures, hematogenous seeding of infectious agents, or trauma and neurosurgical complications [6,10]. While odontomastoiditis is frequently associated with BAs localized in the temporal lobe and cerebellum, frontal and ethmoid sinusitis and odontogenic infection are associated with frontal lobe abscesses [11]. Hematogenous seeding usually causes multiple abscesses [12,13]. However, localization characteristics have a limited value [14]. As many as 20-30% of cases have no identified source of infection [10].



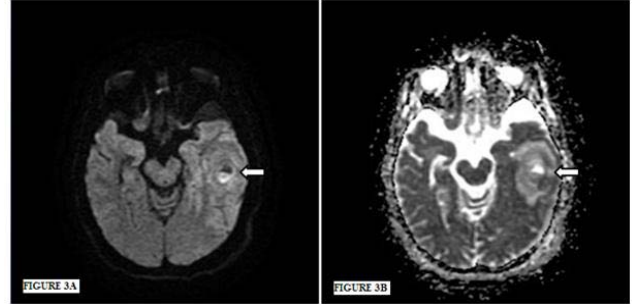
**Figure 1:** Non-contrast cranial computerized tomography revealed a low attenuated and indefinite bordered area causing sulcal effacement in the left temporal lobe (large arrow). There is an incidental arachnoid cyst in front of the left temporal lobe (small arrow).



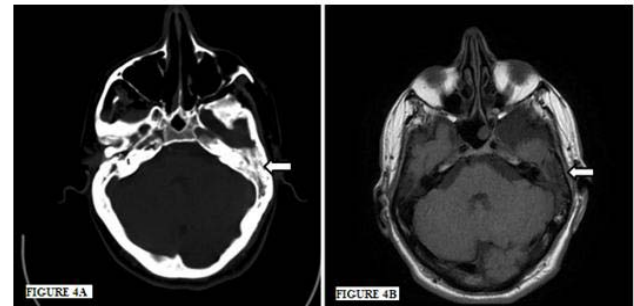
**Figure 2:** T2-weighted cranial magnetic resonance showing abscess cavity with fluid-fluid level. The vasogenic edema surrounding the abscess cavity is characterized by surrounding hyperintensity on the T2-weighted sequence.

A BA develops in four stages [15,16]. The first stage is 'early cerebritis' and occurs in the first to fourth day. In this stage, acute inflammation results in localized cerebral edema. Non-contrast CCT can be normal or shows a poorly marginated, edematous area [6]. The second stage is 'late cerebritis,' which occurs between the fourth and ninth days. In this stage, the central area becomes necrotic. On non-contrast CCT there is persistent poorly defined edema; however, on post-contrast images there is thick ring like enhancement [6]. In this stage, CCT can be insufficient to diagnose the BA. The third and fourth stages are 'early' and 'late capsulation.' During these stages, there is a central core containing pus with a surrounding capsule. On non-contrast CCT, this core presents as a round or ovoid area of low attenuation. Post-contrast CCT images can reveal a ring like enhancement. A CMRI is more sensitive than CT because it has greater sensitivity to changes in tissue water content, resulting in a greater contrast between edematous brain and normal brain early stages of cerebritis and abscess formation [6,17]. A DW-MRI helps distinguish abscesses from other ring-enhancing lesions such as cystic or necrotic neoplasms [18-20]. In our case, the CCT revealed only brain edema, but the CMRI and DWI revealed a cystic lesion with a fluid-fluid level.

The most important prognostic factor for BAs is the initial neurologic grade [21]. Diagnostic delay is a key contributing factor to



**Figure 3:** **Figure 3A:** On diffusion-weighted sequence, the facilitated- and restricted-diffusion are together and they create a clear level. Brain edema surrounds the abscess cavity. **Figure 3B:** On the apparent diffusion coefficient, induced- and reduced- apparent diffusion coefficient values are together and they create a clear level. Brain edema surrounds the abscess cavity.



**Figure 4:** **Figure 4A:** Cranial computerized tomography and **Figure 4B:** Magnetic resonance imaging showing inflammation in left mastoid sinus.

the severity and outcome of BAs [3,22]. The abscesses tend to rupture into ventricles and this a feared complication [6,23].

## Conclusion

Since the timely diagnosis is crucial for BAs, Emergency Physicians (EPs) should be careful while evaluating patients with neurological symptoms and consider the possibility of a BA. Time of presentation and tempo of the disease causes different imaging results in CCT and CMRI and this makes the diagnosis of BA challenging in ED. Diagnostic imaging modality must be chosen by EPs according to the duration of patient's symptoms.

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