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Review

Headache and infections of the central nervous system: neuroradiology

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Abstract

Headache may be a cardinal symptom in a patient with an intracranial infection. Meningitis, meningoencephalitis, empyema, and brain abscess are the most frequent infections of the central nervous system. They are usually accompanied by severe headache, usually acute at onset, accompanied by high temperature, altered level of consciousness, in addition to alterations in the neurologic examination. In this minireview, the authors intend to show and comment on some neuroimaging aspects found during the investigation of patients with a headache caused by an infectious intracranial lesion.

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Introduction

Headache may be a cardinal symptom in a patient with an intracranial infection.[1-4] Meningitis, meningoencephalitis, empyema, and brain abscess are intracranial infections that may affect the central nervous system, and pain is frequently a major alarm sign. They are usually accompanied by severe headache, usually acute at onset, accompanied by high temperature, altered level of consciousness, in addition to alterations in the neurologic examination.

In this minireview, the authors intend to show and comment on some neuroimaging aspects found during the investigation of patients with a headache caused by an infectious intracranial lesion.

Meningitis and cerebral abscess

Meningitis can have numerous causes, from infectious causes to chemical reasons. Both bacterial and viral meningitis evolve in some cases with serious complications, often leading to the patient's death. In bacterial meningitis, empyemas (i.e., purulent collections that occupy a pre-existing space in the body) and brain abscesses (i.e., parenchymal purulent collections) are complications. In brain abscesses that originate from an ear infection, the temporal lobe or the cerebellum is the most frequent site. On the other hand, when the cause is bacterial sinusitis, the frontal lobe is the most affected. Multiple abscesses are more frequent due to hematogenous bacterial dissemination or septic emboli that have a distinct origin, such as in pulmonary infections. In herpes encephalitis, the temporal lobes are preferentially affected.

Treatment of possible acute bacterial meningitis should not be postponed until imaging tests are performed, as the findings are subtle and nonspecific. Non-contrast tomography may be normal or show mild hyperattenuation in the cerebral sulci. On MRI, hypersignal is observed in the cerebral sulci in FLAIR due to increased protein content. Additional sequences such as FLAIR post-contrast and T1-post-late contrast increase the sensitivity of the examination and should be added in suspected meningitis; in these sequences, fine linear enhancement is observed in the cerebral sulci in bacterial and viral meningitis, while the enhancement of a dense nodule in the basal cisterns is more typical of granulomatous or carcinomatous meningitis. CSF analysis is the gold standard for diagnosing meningitis. Neuroimaging is most helpful in excluding herniations before lumbar puncture and may detect complications such as hydrocephalus.[5,6] Abscesses show ring-shaped impregnation in contrast-enhanced CT and MRI phases (Figure 1). Therefore, it is essential to distinguish brain abscess from neoplasm with necrosis (e.g., brain metastasis and glioblastoma).[7] This distinction can be made through the advanced sequence of brain MRI called "diffusion" and associated with the cerebral blood perfusion sequence.[8]

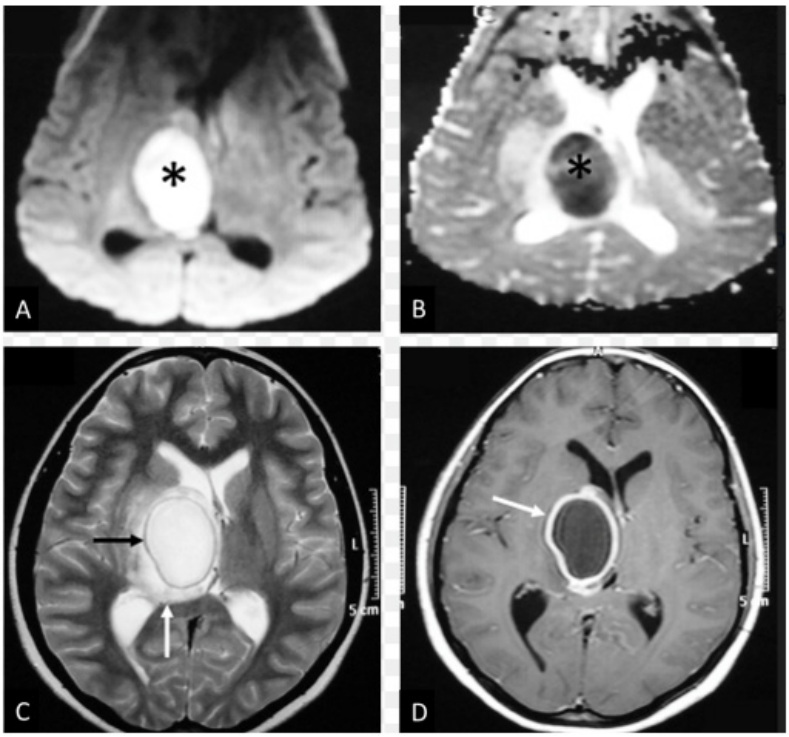

Figure 1. Brain abscess. Diffusion axial magnetic resonance imaging (A), ADC map (B), T2 (C) and post-contrast T1 (D) images show an oval formation centered in the right thalamus with content showing restriction to the diffusion of water molecules (*), T2 hyposignal halo (black arrow) and post-contrast peripheral ring enhancement (white arrow). Surrounding the lesion, there is vasogenic edema.

Tuberculous meningitis can present as meningitis affecting both the leptomeninges and the pachymeninges, being more evident at the skull base and often associated with hydrocephalus. Tuberculoma can be found in the brain parenchyma, which is classically characterized by hyposignal on T2-weighted images, and less commonly tuberculous abscesses that present hypersignal on T2 in their content, which is not impregnated by the contrast, located internally in the capsule that is impregnated.[9]

Sinusitis and Otitis

Sinusitis and ear infections are common causes of headache. There are also other causes of headache or facial pain attributed to disorders of the skull, neck, eyes, ears, nose, sinuses (Figure 2), teeth, mouth, or other facial or cranial structures.

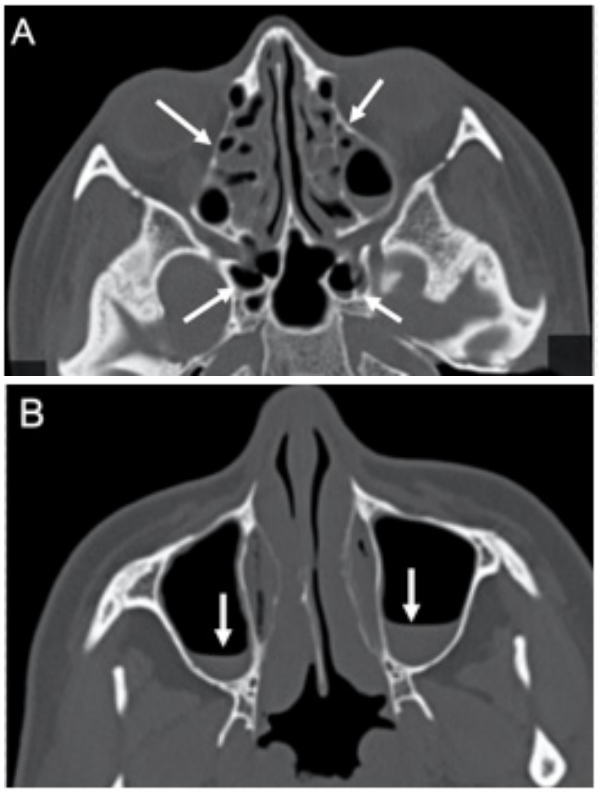

Figure 2. Sinusopathy. Axial computed tomography images without contrast in the bone window show thickening of the mucous lining of the ethmoidal trabeculae and sphenoid sinuses (arrows, A) and secretion forming a fluid level in the maxillary sinuses (arrows, B).

Headache Associated with Covid-19 Infection

The coronavirus is one of the main viruses whose main target is the human respiratory system, but it also has neuroinvasive capabilities and can spread from the respiratory tract to the central nervous system. Headache, anosmia, and ageusia are frequent neurological symptoms.[9-20]

Patients with Corona-19 virus disease (Covid-19) may present neurological symptoms with repercussions on imaging exams; and an association with ischemic infarction has been described[21,22], as well as hemorrhagic lesions[23], acute hemorrhagic necrotizing encephalopathy[24], cerebral venous thrombosis[25], and diffuse leukoencephalopathy with microhemorrhage.[26]

Microhemorrhagic lesions and impregnation in the olfactory bulbs of patients with Covid-19 with or without anosmia have been described using the "coronal technique with thin T1 cuts with fat suppression in the anterior cranial fossa" pre- and post-contrast.[27] Since there exists a spectrum of the disease, these findings can help to be suspicious of the diagnosis of Covid-19, especially when the patient is being investigated by MRI with a picture of a refractory headache of unexplained cause with or without other complaints or signs. As there is a spectrum of Covid-19 that can manifest without flu and respiratory syndrome, the suspicion of Covid-19 may not be raised in neurological patients. For this reason, it was suggested to include this sequence in brain MRI protocols routinely.[27]

Conclusion

The authors concluded that an investigation with neuroimaging is of significant importance to disclose intracranial lesions when an infectious disease is the cause of headache in a patient with fever and focal neurological deficit.

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Authors' contribution
MFVVA and LCA, wrote the article and the selection of the figure; MMV, the final edit of the manuscript.

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