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Original Research Paper

Radiodiagnosis

CEREBRAL ABSCESS AND ITS RADIOGRAPHIC APPEARANCE IN COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING

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ABSTRACT

Cerebral abscesses result from pathogens growing within the brain parenchyma, initially as acerebritis and then eventually demarcating into a cerebral abscess. Historically direct extension from sinus or scalp infections was the most common source. More recently hematological spread has become most common. Direct introduction by trauma or surgery accounts for only a small minority of cases.

The aim of this study is to characterize the radiographic features of brain abscess, such as the appearance and enhancement on Computed Tomography and Magnetic Resonance Imaging. And also to find out which is the most effective imaging method to diagnose. Fifteen patients were studied retrospectively from the PACS of CT Scanner and MRI using the protocol of imaging head.

Both CT and MRI demonstrate similar features. MRI has a greater ability to distinguish a cerebral abscess from other ring-enhancing lesions. The study concludes that MRI is more sensitive and especially with the addition FLAIR and DWI far more specific for the diagnosis of cerebral abscesses.

KEYWORDS : Cerebral abscess, Computed tomography, Magnetic resonance imaging, radiographic features

INTRODUCTION

Abscesses are similar to empyema, as both are defined inflammatory collections. The difference is that abscesses occur in the parenchyma of the affected organ while empyema arise in a pre-existing cavity such as the pleural space.

Abscesses are focal confined collection of suppurative inflammatory material and can be thought of as having three components[1].

(i) A central core consisting of necrotic inflammatory cells and local tissue
(ii) Peripheral halo of viable neutrophils
(iii) Surrounded by a capsule with dilated blood vessels and proliferation of fibroblasts.

The presentation of an abscess is varied depending on the location and its infiltration of and mass effect on local structures. Systemically, patients with abscesses can present with a swinging pyrexia and raised inflammatory markers, which are resistant to antimicrobial therapy. Pain is a common accompanying symptom. The hallmark signs of subcutaneous abscesses are pain, warmth, redness, and swelling. Abscesses can be caused by bacteria, parasites, or fungi.

Any tissue in the body can play host to abscesses. Some of the commonly existing abscess are

Bezold Abscess
Breast Abscess
Brodie Abscess
Cerebral Abscess
Liver Abscess
Pulmonary Abscess
Renal Abscess
Spinal Epidural Abscess
Splenic Abscess
Subcutaneous Abscess

Cerebral abscess is an abscess caused by inflammation and collection of infected material, coming from local infectious sources, within the brain tissue. Clinical presentation is non-specific with many cases having no convincing inflammatory or septic symptoms. Symptoms of raised intracranial pressure, seizures and focal neurological deficits are the most common forms of presentation. Eventually, many abscesses rupture into ventricular system, which results in a sudden and dramatic worsening of the clinical presentation and often heralds a poor outcome.

Cerebral abscesses result from pathogens growing within the brain parenchyma, initially as acerebritis and then eventually demarcating into a cerebral abscess. Historically direct extension from sinus or scalp infections was the most common source. More recently haematological spread has become most common. Direct introduction by trauma or surgery accounts for only a small minority of cases[3].

Cerebral abscess is a potentially life-threatening condition requiring rapid treatment, and prompt radiological identification. Fortunately, MRI is usually able to convincingly make the diagnosis, distinguishing abscesses from other ring-enhancing lesions.

Microbiology

- *Streptococcus sp*: 35-50%[3]
- especially *S. pneumoniae*[4]
- sterile: 25%
- mixed: variable, 10-90% of cases depending on source[3]
- *Staphylococcus aureus* and *epidermidis*: following neurosurgery
- Gram-negative species more common in infants
- Listeria in pregnant women and older patients
- group B strep (GBS) and E coli in neonates

The immunocompromised patient is susceptible to a host of other organisms including[3]:

- *Toxoplasma gondii*
- *Nocardia asteroides*
- *Candida albicans*
- *Listeria monocytogenes*
- *Mycobacterium sp*
- *Aspergillus fumigatus*

Four stages are recognised, which distinct pathological and radiological features:

1. early cerebritis
2. late cerebritis
3. early capsule
4. late capsule

MATERIALS AND METHODS

This is a retrospective study conducted during the period between 2015 and 2017. Patients were imaged with either one or two imaging modalities, Computed Tomography and Magnetic Resonance Imaging. Some patients of this sample were scanned

using a 64 multi slice CT scan using the protocol of the brain imaging in which the patient was scan in supine position with the head of the patient is centered and fixed in the Gantry of CT Scan machine. Brain scan was done under selected exposure factors with slice thickness of 8 mm and intravenous Low Osmolar Water soluble Contrast Media (LOCM) was injected to the patients. Interpretation of the brain scan was performed by consultant radiologists to conform the diagnosis. The remaining patients of this study were imaged with 1.5 Tesla Magnetic Resonance Imaging (MRI) by using the protocol of imaging of the head by MRI in which the following parameters of imaging were selected; 10 mm slice thickness of the brain, T1 and T2 with contrast and fat suppression, FLAIR, DWI and SWI weighted images were done and the contrast media that used is intravenous Gadolinium (0.1 ml/kg) according to the weight of the patient.

RADIOGRAPHIC FEATURES

Both CT and MRI demonstrate similar features, although MRI has a greater ability to distinguish a cerebral abscess from other ring-enhancing lesions.

By stage

1. early cerebritis

- may be invisible on CT
- poorly marginated cortical or subcortical hypodensity with mass effect with little or absence of enhancement

2. late cerebritis

- irregular rim-enhancing lesion with a hypodense centre, better defined than early cerebritis

3. early capsule

- well-defined rim-enhancing mass, an outer hypodense and inner hyperdense rim (double rim sign) is seen in most cases

4. late capsule

- rim-enhancing lesion with thickened capsule and diminished hypodense central cavity

RESULT

CT

In patients with suspected intraparenchymal sepsis, pre- and postcontrast scans should be obtained, unless the plan is to proceed to MRI regardless of the CT findings. Typical appearances include:

- ring of iso- or hyperdense tissue, typically of uniform thickness
- central low attenuation (fluid/pus)
- surrounding low density (vasogenic oedema)
- ventriculitis may be present, seen as enhancement of the ependyma
- obstructive hydrocephalus will commonly be seen when intraventricular spread has occurred

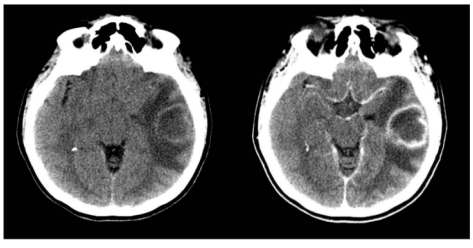

Figure 1(a) Pre-contrast CT image shows a round intra-axial lesion with vasogenic edema.
Figure 1(b) Post contrast CT image shows a thin and smooth wall enhancement.

MRI

MRI is more sensitive and especially with the addition MRS and DWI far more specific for the diagnosis of cerebral abscesses.

- **T1**
- central low intensity (hyperintense to CSF)
- peripheral low intensity (vasogenic oedema)
- ring enhancement
- ventriculitis may be present, in which case hydrocephalus will commonly also be seen

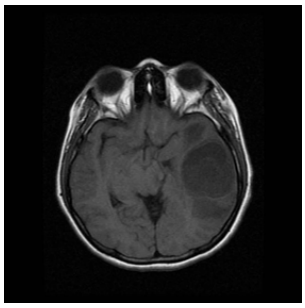

Figure 2 Shows T1 weighted MR Image with round intra-axial lesion with vasogenic edema with a hyper intense thin wall

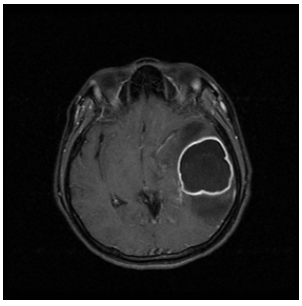

Figure 3 shows T1 weighted MR image with contrast and fat saturation

- **T2/FLAIR (Fluid-attenuated inversion recovery)**
- central high intensity (hypointense to CSF, does not attenuate on FLAIR)
- peripheral high intensity (vasogenic oedema)
- the abscess capsule may be visible as an intermediate to slightly low signal thin rim 1

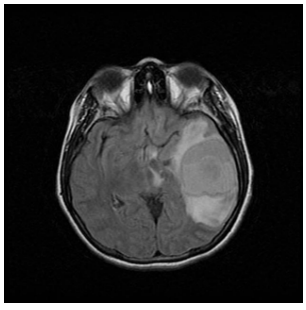

Figure 4 shows MR Axial FLAIR image

- **DWI (Diffusion-weighted magnetic resonance imaging)**

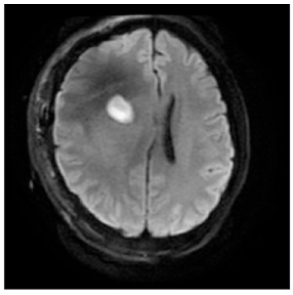

Figure 5 shows MR DWI Axial image

- high DWI signal is usually present centrally [5,11]
- represents true restricted diffusion (low signal on ADC, typically ~650 +/- 160 x 10^{-6} mm^2/s) [10]

- peripheral or patchy restricted diffusion may also be seen; this finding is however not as constant as one may think, with up to half of rim-enhancing lesions demonstrating some restriction not proving to be abscesses [2,6].
- ADC values increase as treatment is successful even if cavity remains [7,8,9]

- **SWI (Susceptibility weighted imaging)**

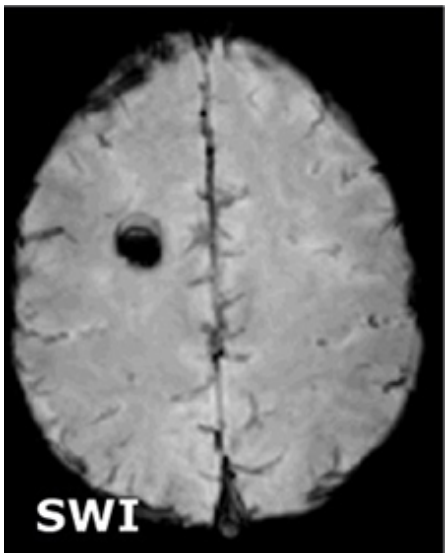

Figure 6 shows MR SWI Axial image

- low-intensity rim 9
- complete in 75%
- smooth in 90%
- mostly overlaps with contrast enhancing rim

CONCLUSION

Both CT and MRI demonstrate similar features, although MRI has a greater ability to distinguish a cerebral abscess from other ring-enhancing lesions.

In cases where the abscess cavity does not completely obliterate, follow-up with MRI including DWI is useful .

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