

**Distinction between Pyogenic Brain
Abscess and Necrotic Brain Tumour
Using 3-Tesla MR Spectroscopy,
Diffusion and Perfusion Imaging**

Essay

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا
عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ

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List of Abbreviations

3D	:	Three dimensional
2D	:	Two dimensional
AAS	:	Anaplastic Astrocytoma
ADC	:	Apparent diffusion coefficient
AIDS	:	Acquired immunodeficiency syndrome
AVM	:	Arterio -venous malformation
Cho	:	Choline
cMRI	:	Conventional magnetic resonance imaging
CNS	:	Central nervous system
Cr	:	Creatine
CSF	:	Cerebrospinal fluid
CSI	:	Chemical shift imaging
CT	:	Computed tomography
DWI	:	Diffusion weighted imaging
EBV	:	Epstein-Barr virus.
FID	:	Free induction decay (FID)
FLAR	:	Fluid attenuation inversion recovery
GBM	:	Glioblastoma multiforme
GC	:	Gliomatosis Cerebri
Gd	:	Gadolinium
Glx	:	Glutamine & Glutamate
HMRS	:	Proton MR spectroscopy
Lac	:	Lactate
LGGs	:	Low-grade gliomas
Lip	:	Lipids
MIns	:	Myo-inositol
MPNST	:	Malignant peripheral nerve sheath tumor
MRI	:	Magnetic resonance imaging
MRS	:	Magnetic resonance spectroscopy
MTT	:	Mean transit time
MV	:	Multivoxel

List of Abbreviations (Cont.)

NAA	: N-Acetylc Aspartate
PCNSL	: Lymphoma.
PCNSL	: Primary Central Nervous System
PDWI	: Proton density-weighted image
PPM	: Parts per million (ppm)
PRESS	: Point resolved spectroscopy
PWI	: Perfusion weighted imaging
rCBF	: Relative cerebral blood flow
rCBV	: Relative cerebral blood volume
RF	: Radio-frequency (RF) pulse
SI	: Spectroscopic imaging
STEAM	: Stimulated echo acquisition mode
SV	: Single Voxel
T	: Tesla
T1WI	: Spin-echo T1-weighted image
T2WI	: T2-weighted image
TE	: TE (time to echo)
TE	: Time evolution
TR	: Time to resonance
VOI	: Volume of interest
WHO	: World Health Organization

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Introduction

Although brain tumours are rare compared with other malignancies, they are responsible, in many cases, for severe physical and cognitive disability and have a high case fatality rate (13% overall survival at 5 years). Gliomas account for over 60% of primary brain tumours and usually present with one or more symptoms of raised intracranial pressure, progressive neurological deficit, seizures and focal or global cognitive decline, another tumours include meningeal tumours, nerve sheath tumours, metastatic deposits and germ cell tumours **(Rees J,2011)**.

The diagnosis is made by a combination of imaging and histological examination of tumour specimen. Contrast-enhanced MRI is the gold standard imaging modality and provides highly sensitive anatomical information about the tumour. Advanced imaging modalities provide complementary information about brain tumour metabolism, blood flow and ultrastructure and are being increasingly incorporated into routine clinical sequences **(Rees J,2011)**.

Brain abscess is a focal intracerebral infection, which begins as a localized area of cerebritis and develops into a collection of pus surrounded by a well-vascularized capsule **(Pala et al., 2010)**.

It is caused by different types of pathogens, but the main organisms that cause brain abscess are of bacterial origin. The bacterial flora involved in this abscess consist of aerobes and anaerobes. Infection occurs either by hematogenous spread from a reservoir outside the central nervous system or by direct invasion from a contiguous site of infection in the paranasal sinuses, mastoid and middle ear **(Pala et al., 2010)**.

Brain abscesses and brain tumors may have similar clinical presentations. For example, only 50% brain abscess patients have fever, which could be masked by corticosteroid therapy. Also, the differential diagnosis of brain abscesses versus cystic or necrotic tumors may be difficult based on computed tomography (CT) or magnetic resonance (MR) imaging findings. However, the strategies of management for abscess and neoplasm are very different, and it is especially imperative to have a correct diagnosis before any surgical intervention of cystic brain lesions (**Ping et al., 2004**).

Spectroscopy, diffusion and perfusion-weighted MRI are advanced MR techniques that are used to add important physiological and metabolic information to that obtained with conventional MRI. This study demonstrates that diffusion (apparent diffusion coefficient (ADC) values of central regions), perfusion-weighted (relative cerebral blood volume(rCBV) values of peripheral regions) and spectroscopic MR measurements can be used to demonstrate differences in cerebral abscesses and necrotic tumours (**Chiang et al., 2009**).

Aim of Work

The purpose of this essay is to highlight the effectiveness of relative cerebral blood volume, apparent diffusion coefficient and spectroscopic imaging in differentiating between cerebral abscesses and necrotic brain tumors that could be similar at conventional MRI study.

Anatomy of the Brain

Meningeal Covering of the Brain

Dura mater

This is a tough membrane described as having two layers. The outer layer is, in fact, the periosteum of the inner aspect of the skull and is continuous through all the foramina and sutures of the skull with the periosteum on the outside of the skull. The inner layer is the dura mater proper (**Standring et al., 2005**).

This is, however, densely adherent to the outer layer in all places except where the layers separate around the dural venous sinuses and where the inner layer projects inwardly as the falx cerebri and cerebelli, and as the tentorium cerebelli and the diaphragma sellae (**Standring et al., 2005**).

The falx cerebri is a sickle-shaped dural septum in the median sagittal plane attached to the crista galli in the midline of the floor of the anterior cranial fossa and along the midline of the inner aspect of the vault of the skull to the margins of the superior sagittal sinus. (**Standring et al., 2005**).

The tentorium cerebelli is a horizontal septum of dura mater that separates the occipital lobes from the superior surface of the cerebellum. The falx cerebelli is a low elevation of dura that projects a small distance into the cerebellar interhemispheric fissure (**Standring et al., 2005**).

Arachnoid mater

This layer of meninges is a delicate membrane which is impermeable to CSF. It lines the dura mater, separated from it only by a thin layer of lymph in the subdural (potential) space (**Stephanie et al., 2007**).

It is separated from the pia mater by the subarachnoid space, which contains the CSF. The arachnoid mater projects into the interhemispheric fissure and into the root of the sylvian fissure, but otherwise does not dip into the sulci. It surrounds the cranial and spinal nerves in a loose sheath as far as their exit from the skull and vertebral canal. Arachnoid mater herniates through holes in the dura into the venous sinuses and venous lakes as arachnoid villi (cf. CSF absorption), and only in these villi is the arachnoidpervious to CSF (Stephanie et al., 2007).

Pia mater

This meningeal layer is closely adherent to the brain surface and dips into all the sulci. It continues along all the cranial and spinal nerves and fuses with their epineurium. It is also invaginated into the surface of the brain by the entering cerebral arteries. It invaginates with the choroid vessels into the ventricles, and the layer of pia mater and ependyma together thus formed over these vessels is called the tela choroidea of the ventricles (Stephanie et al., 2007).

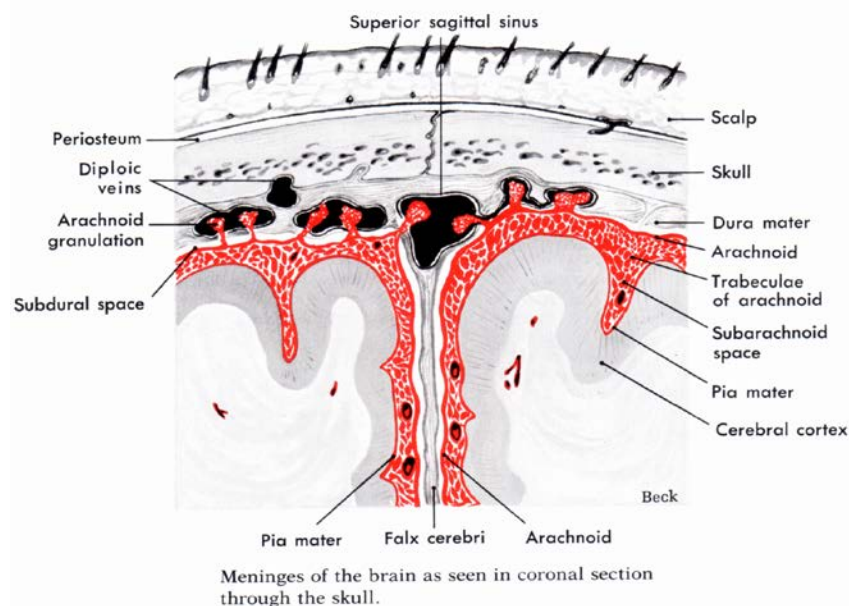


Fig. (1):Coronal section through the skull. (Quoted from <http://www.arthursclipart.org> web site)

The cerebral hemispheres

The cerebral hemispheres fill the cranial vault above the tentorium cerebelli. Right and left hemispheres are connected by the corpus callosum and are partly separated by the median longitudinal fissure. The hemispheres consist of cortical grey matter, white matter, basal ganglia, thalamus, hypothalamus, pituitary gland and the limbic lobe. The lateral ventricles form a cavity within each ventricle **(Stephanie, et al 2007)**.

The cerebral hemispheres are the largest part of the brain. They each have an external highly convoluted cortex, beneath which lies an extensive internal mass of white matter that contains the basal ganglia. Each hemisphere also contains a lateral ventricle, continuous with the third ventricle through the interventricular foramen **(Standring et al., 2005)**.

The two hemispheres are linked by the commissural fibers of the corpus callosum. The cerebral hemispheres are separated by a deep median cleft, the great longitudinal fissure, which contains a crescentic fold of the dura mater, the falx cerebri. Each cerebral hemisphere presents superolateral, medial and inferior surfaces or aspects **(Standring et al., 2005)**.

Basal ganglia

These compact masses of grey matter are situated deep in the substance of the cerebral hemisphere and comprise the corpus striatum (composed of the caudate nucleus, the putamen and the globus pallidus) and the claustrum. Together with the cerebellum, they are involved in co-ordination and control of movement **(Harold et al., 2006)**.

The corpus striatum

The caudate nucleus is a large homogeneous mass of grey matter consisting of a head, anterior to the