

The Brain in AIDS: Some observations on CT Scan

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Introduction:

The incidence and severity of the HIV epidemic varies widely in various regions resulting from variations in risk behavior, duration of disease and the availability of treatment.

HIV is highly neurotropic and crosses the blood brain barrier at an early stage in the disease process. Thus the CNS is a major target of HIV with approximately 2/3 of the patients developing CNS involvement during the course of the disease. The incidence of sub clinical neurological disease is even higher; autopsy studies of patients with advanced HIV disease have demonstrated pathological abnormalities of the nervous system in 75-90% of the cases ^{1,2}.

Though the availability of HAART has been associated with a dramatic decline in the incidence and severity of opportunistic infection in CNS, in developing poor countries where health resources are limited, the disease pattern is complex and diseases of the CNS remain a dominant cause of morbidity and mortality in AIDS patients. Poverty, inability to afford the treatment, inadequate diagnostic facilities, treatment and monitoring etc. are very straightforward underlying factors.

Many advances in laboratory diagnostic techniques have increased the ability to make a specific diagnosis; however a large part of the diagnostic process still relies on radiological examination. MRI is the best possible choice of imaging technique. In poor countries like Zambia where MRI scan is unavailable, CT allows it to remain a first line screening tool prior to lumbar puncture or any other invasive investigation.

Material and Method:

In this article we report our experience, a prospective study conducted between 2001-2004, with brain CT scans of 200 patients with a laboratory diagnosis of AIDS (Reactive to Abbot Determine test for HIV as recorded in laboratory reports in case files) and evaluate its role in the diagnosis of the disease. In addition, pertinent literature regarding this disease has also been reviewed.

The patient population consisted of 120 males and 80 females. There were 5 neonates, 12 of pediatric age group and the rest were adult. All scans were performed using the Philips CT aura machine.

Clinical presentation:

Most of the patients had more than one problem. The clinical picture was nonspecific, and on many occasions, unhelpful in distinguishing between the wide varieties of

Table 1: Distribution of symptoms of patients under study

Symptoms	No of cases	% of Cases
Headaches with or without fever	34	17%
Fits	24	12%
Stroke/Hemiplegia	12	6%
Altered mental status Dementia/confusion/ unconsciousness	78	39%
Posterior fossa symptoms and signs - vertigo/diplopia/gait disturbance/ataxia e.t.c	52	26%
Total number of cases	200	

the neurological disease spectrum in AIDS. It could be from mild cognitive impairment to frank neurological deficit and in extreme cases, unconsciousness. Patients reported for CT scan with one or more of the following symptoms.

Headache:

This is a common and difficult problem in patients with HIV, (though some may have benign headaches). Meningitis, encephalitis, cerebral vasculitis and mass lesions can all present with headaches. Any headache of recent onset or change in headache patterns requires an urgent CT scan followed by lumbar puncture unless contraindicated by the presence of mass lesion. Associated fever always suggests infection of any type of underlying organism.

Fits:

The common cause could be encephalitis, HIV associated dementia, meningitis or mass lesion. In about 20% of the patients no definite etiology for these fits could be found.

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Altered mental status:

Acute encephalopathy, opportunistic infection, neoplasm, can all be present with progressive cognitive decline and personality changes, with or without focal deficit.

Posterior fossa symptoms and signs:

Manifestations could be in the form of vertigo, diplopia, headache, cerebellar ataxia, gait disturbance and cranial nerve deficit with or without sensory loss.

Stroke:

Cerebral infarction and transient ischemic attack are not an uncommon presentation. Cerebral vasculitis or vasculopathies due to chronic meningitis may cause thrombotic stroke in patients with HIV. Hemorrhage is occasionally seen in the zoster vasculitis, thrombocytopenia, or rarely, metastatic Kaposi's sarcoma.

CT scan findings:

The variety of neuro-imaging abnormalities encountered in AIDS is complex. Several patterns were seen in the CT scans. A systematic approach is needed to interpret the imaging features, as there is a considerable overlap. Our patients displayed the following signs:

CT Scan Findings	No. of Cases
Generalized Atrophy	64
Periventricular low density	55
Single or multiple abscesses	16 (CSF showed bacterial infection)
Infarction	20 (12 cases showed infarction in major vessel. Others showed single or multiple lacunar infarction of
Progressive multifocal leucoencephalopathy	28
Mass lesion	7(2 cases were confirmed as Non Hodgkin lymphoma on cervical lymph node biopsy. Rest were due
Meningeal enhancement	8 (2 cases have responded well on ATT)
Hypoxic changes	05 (ALL WERE NEONATES FROM hiv+ve mothers)
Periventricular or cortical calcification	9 (5 neonates. Diagnosis was confirmed by CMV positive culture in urine, rest of the adults were Toxoplasmosis +ve confirmed by
Focal cerebritis	12

Table 2: CT scan findings in patients under study
NB. Some of the patients displayed more than one sign

Discussion:

Whether the symptoms are due to a direct effect of HIV, opportunistic infection, neoplasm or vascular lesion, broadly speaking the CT scan signs are as follows:

Diffuse White Matter Disease:

The sole abnormality may be generalized cerebral atrophy or bilateral symmetrical low density lesion in the periventricular region. There is no mass effect and no contrast enhancement. Diffuse white matter lesions are due to a direct effect of HIV itself. It presents progressive dementia or gait disturbance and tremors. Collectively it is the radiological correlate of AIDS dementia complex ⁴.

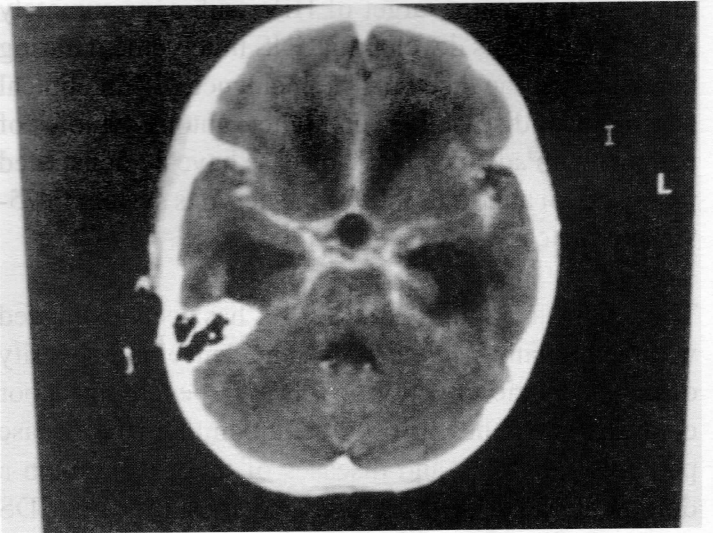


Image 1: A case of congenital CMV - dilated ventricles with brain atrophy. Thick and enhanced basal meninges are due to meningitis.

In neonates from HIV +ve mothers with poor immunity, white matter lesions could be due to Cytomegalovirus, an opportunistic infection (image 1). The dilated lateral ventricle with periventricular or cortical calcification on CT scan is a classical picture ⁵.

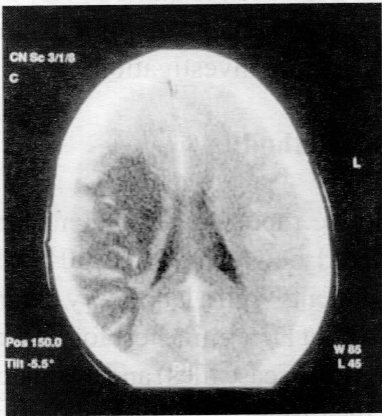


Image 2: A case of dementia with Progressive Multifocal Leucoencephalopathy. Ill-defined hypodense non-enhancing lesion in both parietal lobes. Despite its size, not associated with any mass effect.

Progressive Multifocal Leukoencephalopathy:

A scalloped configuration, predominantly in the region coupled with atrophy and in the absence of enhancement and mass effect, one should consider the diagnosis of PML⁶. It is a rapidly progressive AIDS defining disease of the CNS caused by JC papovavirus, when immunity becomes impaired (Image 2).

Differentiation between PML and HIVE is very important, owing to the difference in the prognosis between the two conditions. Lab diagnoses like PCR are highly sensitive and specific.

A predilection for the medial temporal and inferior frontal lobe, ill-defined edema with tiny hemorrhagic points could be taken as the case of Herpes viral encephalitis. We did not see any typical case in our study.

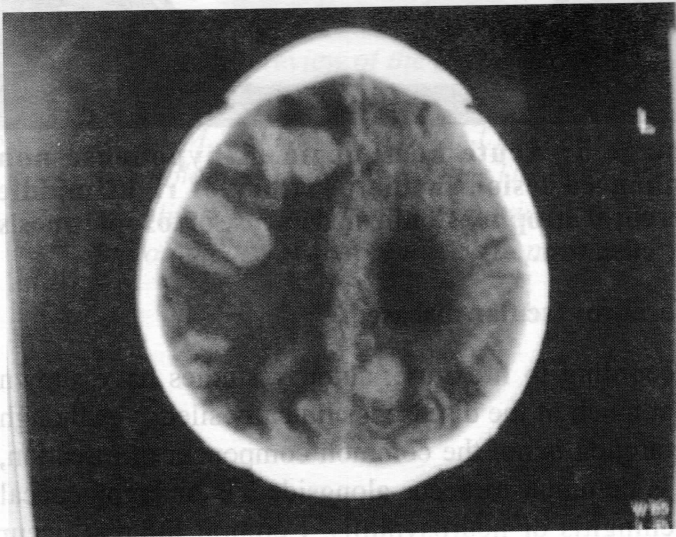


Image 3: A case presented with signs of increased intracranial tension. Confirmed as case of toxoplasmosis: multifocal nodular enhanced lesion with massive oedema in surrounding.

Focal Mass with enhancement:

Multiple ring or nodular enhancing lesions with peripheral edema and mass effect in the basal ganglia or at the grey white matter junction with or without few tiny calcification, is the CT scan picture of Toxoplasmosis encephalitis (Image 3).

Toxoplasmosis infection in a patient with an impaired immune system has become a major cause of encephalitis in AIDS patients. The probability of ever developing toxoplasmosis encephalitis after the onset of AIDS has been estimated at 28%. It is said to be the most eminently treatable among all the CNS infection in the population⁷.

Distinguishing between Toxoplasmosis and Lymphoma often poses a diagnostic challenge to the radiologist, owing to their varied and similar appearance. Rapid and definite diagnosis is essential as treatment regimen and prognosis for the two are extreme. In a poor country such as Zambia where there are no further imaging or advanced lab facilities, clinicians can request for repeat CT scans after 14 days of treatment (sulphadiazine + TMP) with any intracranial mass lesion⁷. Brain biopsy though indicated is not free from risk.

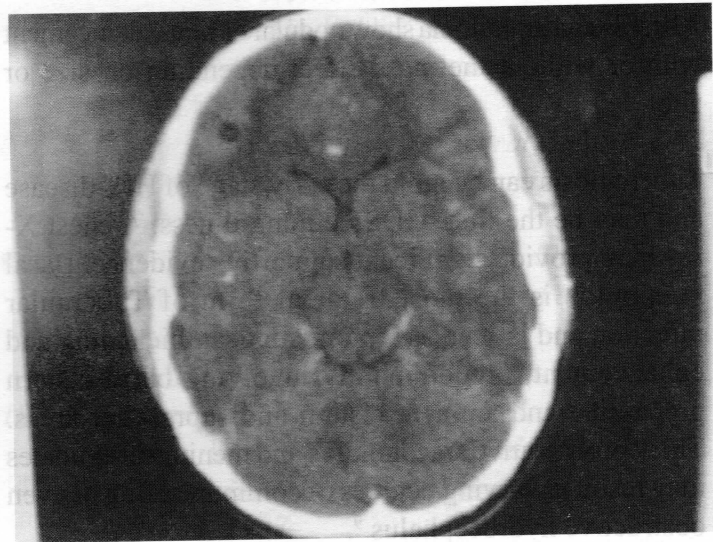


Image 4: A case of generalized seizure showing tiny abscess in right frontal lobe.

Focal Cerebritis:

The initial manifestation of bacterial infection is of a cerebritis, seen as an area of edema with poorly defined contrast enhancement. The patient usually displays



Image 5: A case of severe headache showing multiple hypodense with ring enhancement and surrounding oedema: abscesses.

fits. A wall eventually forms to produce an abscess if not well controlled at this stage (Image 4).

Infections:

Most of the infections give rise to a spectrum of radiological appearances including meningitis, meningoencephalitis, micro abscesses, abscess, granulomas, endometitis mycotic aneurysm, vascular invasion (Image 5).

Abscess and granuloma show nodular or ring enhancement with or without the mass effect depending on size or site.

Tuberculosis can occur in the early stage of HIV disease and may be the first AIDS defining illness. A chest X-ray may provide significant supportive evidence. Basal meningitis is the most frequent form of Tubercular infection and is seen as leptomeningeal thickening and enhancement, predominantly involving basal cistern prefrontal and ambient cistern and suprasellar areas. Thick proliferative arachnoiditis and meningeal exudates may result in varying degrees of communicating or even obstructive hydrocephalus ⁹.

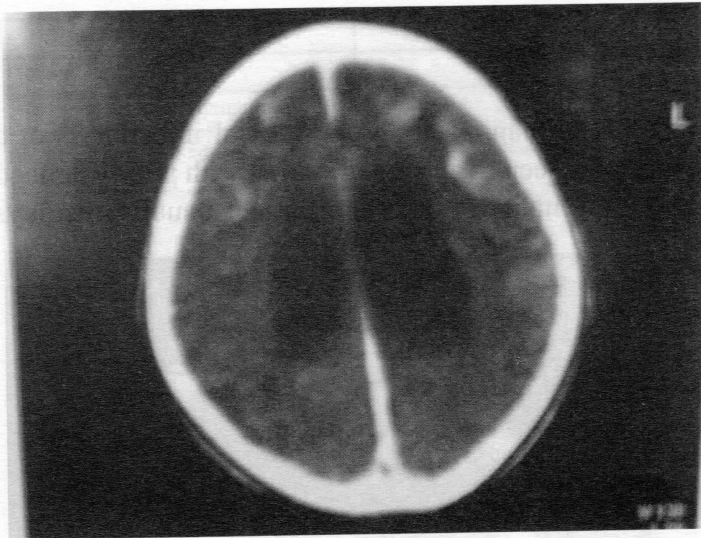


Image 6: A case of cryptococcal meningitis diagnosed by ELISA test shows widespread meningeal enhancement and dilated ventricles

Cryptococcal infection though quite a common infection in AIDS patients, is rarely revealed as any specific abnormality by CT imaging. Laboratory correlation is really required to confirm the diagnosis (Image 6).

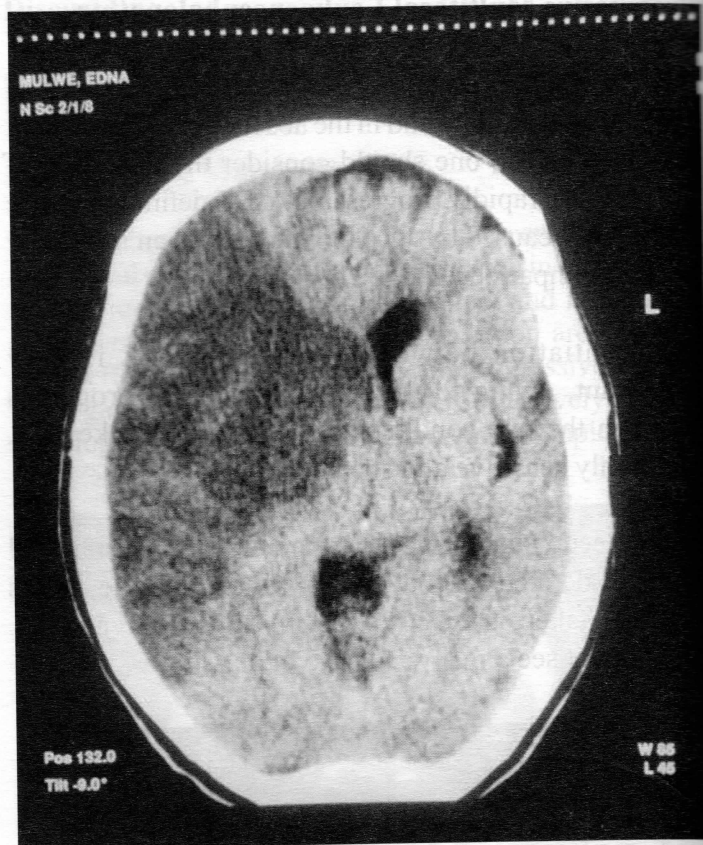


Image 7: Acute hemiplegia. A hypodense non enhanced lesion in the territory of right middle cerebral atrophy. Confirmed as case of toxoplasmosis by elisa test.

Cerebrovascular disease:

According to literature, autopsy studies have shown that much of the disease is clinically silent ⁹. Although infarction is not the common component of infection, it is common to occur alongside TB or cryptococcal meningitis or neurosyphilis. Cerebral infarcts occur from arteritis, vasospasm and thrombosis of the small vessel as in TB meningitis or vasculitis of large vessels in neurosyphilis and cerebral vasculitis with many opportunistic infection like CMV, Toxoplasmosis and VZV infection ¹.

Summary:

This study is a prospective study based on our observations. We conclude it as follows:

1. CT alone is sufficiently sensitive in evaluating AIDS related brain abnormalities. In resources poor setting, it may allow clinician to make appropriate therapeutic decision without inordinate delay.
2. To avoid any complications, lumbar puncture should not be performed in patients with altered mental status, papilledema or focal neurological

deficit until the presence of a mass lesion has been ruled out by CT imaging.

3. Though biopsy is a reliable method for a definite diagnosis of any focal mass in brain, repeat CT scans after the therapeutic trial is a simple risk-free way out if condition permit.
4. Demyelination (periventricular low density) with or without generalized cerebral or cerebellar atrophy, a dominant CT scan feature, if seen in young adults should raise the possibility of AIDS related brain disease.

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