ORIGINAL ARTICLE

COMPUTED TOMOGRAPHIC FINDINGS OF CENTRAL NERVOUS SYSTEM IN HUMAN IMMUNODEFICIENCY VIRUS INFECTED INDIVIDUALS

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ABSTRACT

BACKGROUND: HIV is the etiologic agent of AIDS which belongs to the family of human retroviruses. The clinical disease of the nervous system accounts for a significant degree of morbidity in a high percentage of patients with HIV infection. **OBJECTIVES OF STUDY:** To determine the role of computed tomography in central nervous system manifestations of human immunodeficiency virus infected individuals and assessment of the site, nature and extent of lesions. **MATERIAL & METHODS:** Sixty patients infected by HIV retovirus having CNS manifestations were subjected to the computed tomography brain using Philips 6 slice MDCT scanner. **RESULTS:** The age range was 5-60 years, peak incidence 30-39 years with mean age of 33.03 ± 12.44 years. There were 44 (73.33%) male and 16 (26.67%) female, with male to female ratio of 2.75:1. The commonest complaint was altered sensorium in 25(41.7%) cases,followed by headache 24 (40%) cases, seizures 14(23.3%) cases, and fever 11(18.3%) cases. 34(56.67%) cases were having focal lesions with hypodense lesions in 33(55%) cases, hyperdense lesions in 8 (13.33%) cases and isodense lesion 3(5%) cases. Majority of the focal lesions 32 cases(53.33%) had supratentorial location. 51.51% of cases of the hypodense lesions were located in the basal ganglionic region while 48.48% of cases were located in the cerebral hemispheres. Ring or nodular enhancing hyperdense or isodense lesions were seen in 11.67% mostly supratentorial in location. Cerebral atrophy was seen in 23(38.33%) cases. **CONCLUSIONS:** CT scan is widely available, simple to perform and can be performed quickly on confused, delirious patients. It can provide the clinician with diagnostic as well as prognostic information for a better patient management.

Key words: Computed Tomography; CNS; HIV

Introduction

Human immunodeficiency virus (HIV) is the etiologic agent of autoimmune deficiency syndrome (AIDS) which belongs to the family of human retroviruses (retroviridae) and the subfamily of lentiviruses. The currently defined groups of HIV-1 9 (M,N,O,P) and the HIV-2 groups A through G each. More than 95% of people living with HIV/AIDS reside in low- and middle-income countries with 50% are females, and 2.5 million are children <15 years. Clinical disease of the nervous system accounts for a significant degree of morbidity in a high percentage of patients with HIV infection.[1]

1. Opportunistic infections i.e. Toxoplasmosis, Cryptococcosis, Progressive multifocal leuko-encephalopathy, Cytomegalovirus Syphilis, Mycobacterium tuberculosis, HTLV-1 infection, Amebiasis.
2. Neoplasms i.e. Primary central nervous system (CNS) lymphoma, Kaposi's sarcoma.
3. Result of HIV-1 i.e. Aseptic meningitis, HIV-associated neurocognitive disorders, including HIV, Encephalopathy/AIDS dementia complex.

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4. Myelopathy i.e. Vascular myelopathy, Pure sensory ataxia Paresthesia/dysesth.
5. Peripheral neuropathy i.e. Acute inflammatory demylinating polyneuropathy (Guillain-Barre syndrome), Chronic inflammatory demyelinating pholyneuropathy (CIDP), Mononeuritis multiplex, Distal symmetric pholyneuropathy.

Acute meningitis or encephalitis may be a component of the acute HIV syndrome. The term HIV-associated neurocognitive disorders (HAND) is used to describe a spectrum of disorders that range from asymptomatic neurocognitive impairment (ANI) to minor neurocognitive disorder (MND) to clinical severe dementia. The most severe form, HIV-associated dementia(HAD), also referred to as the AIDS dementia complex, or HIV encephalopathy, is considered an AIDS-defining illness.[1]

Both magnetic resonance imaging (MRI) and computed tomography (CT) can effectively screen for cerebral atrophy, present in virtually all patients with clinically significant HIV encephalopathy. Central atrophy (ventricular enlargement) predominates over cortical atrophy (sulcal prominence).[2] HIV encephalopathy does not result in mass effect or enhancement. If either of these findings is present, another diagnosis must be considered.[3]

Among the more frequent opportunistic diseases that involve the CNS are toxoplasmosis, Cryptococcus, progressive multifocal leukoencephalopathy, and primary CNS lymphoma. Aseptic meningitis is seen in very late stages of HIV infection in the setting of acute primary infection.

Objectives of Study

1. To determine the role of computed tomography in central nervous system manifestations of human immunodeficiency virus infected individuals.

2. Assessment of the site, nature and extent of lesion with computed tomography in HIV infected individuals.

Material and Methods

The present study of computed tomographic (CT) findings of central nervous system manifestations in Human Immunodeficiency Virus (HIV) infected individuals was conducted on sixty patients in the Department of Radiodiagnosis, Government Medical College, Amritsar, India. The patients with clinical symptoms and laboratory diagnosis as HIV infected with neurologic symptoms were selected. The case selection was done comprising of all age groups, who were seropositive for HIV presenting with neurological symptoms and signs. HIV positive patients with trauma or with any other non-neurological complaints were excluded from the study.

After taking the informed consent, each patient was subjected to cranial computed tomography examination. CT examination was performed on Philips Brilliance multislice (six slice) whole body scanner with slice thickness of 6 mm. About 40ml of iodinated contrast agent was used during contrast-enhanced CT scans. The results of study were systematically collected, assimilated and analyzed to draw valid conclusions.

Results

Out of total 60 cases, the age range of patient age was 5-60 years with peak incidence was in the age group of 30-39 years. The mean age was 33.03 ± 12.44 years. Forty four cases (73.33%) were male and 16 cases (26.67%) were female with a male to female ratio of 2.75:1. There was preponderance of males in the age group between 10-50 years. In this age group out of the 52 cases, 40 were males. The mean age of female cases was 32.8 years and for males was 32.9 years.

The commonest complaint was altered sensorium in 25 (41.7%) cases, headache in 24 (40%) cases, seizures in 14 (23.3%) cases, and fever in 11 (18.3%) cases. Neck rigidity was elicited in 4 (6.67%) cases, loss of consciousness and generalized weakness in 6 (10%) cases and hemiparesis were present in 5 (8.3%) cases.

Of 60 study cases, 8 cases were diagnosed as normal study, 34(56.67%)cases were having focal lesions. Hypodense lesions were found in 33(55%)

cases while cerebral atrophy was seen in 23 (38.33%) cases. Hyperdense lesions were seen in 8 (13.33%) cases and isodense lesion in 3(5%) cases (Tab. 1). Majority of the focal lesions 32 cases (53.33%) had supratentorial location.

Pattern on NCCT	No of cases	Percentage (n=60)
Normal	8	13.33%
Cerebral atrophy	23	38.33%
Hypodense lesion	33	55%
Hyperdense lesion	8	13.3%
Isodenselesion	3	5%
Focal lesions	34 single-19 multiple-15	56.67% single - 31.67% multiple - 25%
Mass effect	7	11.67%
Hydrocephalus	8	13.33%
Perilesional edema	5	8.33%

Table 1: Distribution of various patterns of lesions found in non - contrast studies (n=60)

Most of the cases of cerebral atrophy were seen in the age group 30-39 years; out of total 18 patients, 7(11.67%) cases had cerebral atrophy. In the patients with cerebral atrophy, altered sensorium was most common complaint in 52.17% cases followed by headache in 39.13%.

Cerebral atrophy with single or diffuse hypodense lesions without any mass effect, suggestive of HIV encephalopathy was seen in 6(10%) cases. While cerebral atrophy with asymmetrical hypodense lesions, suggestive of PML was seen in 3(5%) cases.

Hypodense lesions with peripheral enhancement suggestive of cerebral toxoplasmosis was seen in 7 (21.21%) cases. Headache and seizure were the most common complaint (4 cases) in this category of patients. The hypodense lesions were single in 5 cases while multiple in 2 cases. 51.51% of cases of the hypodense lesions were located in the basal ganglionic region while 48.48% of cases were located in the cerebral hemispheres.

Ring or nodular enhancing hyperdense or isodense lesions were seen in 11.67% mostly supratentorial in location. Headache and seizures were the most common complaint in these patients. Incidental case of meningioma and ependymoma was seen in 1 case each.

Discussion

CNS disease may be the first expression in AIDS, but it may also occur as a late manifestation. A defect in cell-mediated immunity makes AIDS patients susceptible to opportunistic infections and certain tumors.[4]

In the present study, age of the 60 cases of HIV-infected individuals with CNS symptoms ranged from 5 to 60 years with mean age was 33.03 ± 12.44 years. Our study matches with the study carried by Berhe T et al[5] out in 105 patients with age range of 14 - 65 years and the mean age of 34.6 years. Oliveira JF et al[6] conducted a study in 194 patients and have found the mean age to be 35.8 ± 0.6 years with age range of 18 to 65 years. In the present study most of the patients, 33(55%) cases were in the age group 30-49 years (Tab. 2). Hongsakul K and Laothamatus J[7] reported maximum no of cases (57.4%) were in the age group 18-35 years, while Patel ML et al[6] found that majority of patients (49.5%) were 31-40 years of age.

Study Comparison	Study population	Mean age
Hongsakul K and Laothamatus J	195	34 years
Berhe T et al	347	34.6 years
Patel ML et al	105	34.28 years
Oliveira JF et al	194	35.8 years
Present study	60	33.03 years

Table 2

In the present study of 60 cases, 44 patients were male and 16 patients female with a ratio of 2.75:1. Hongsakul K and Laothamatus J[7] reported a male to female ratio of 1.4:1. Berhe T et al[5] reported a ratio of 4.5:1 which is higher than the present study. Oliveira JF et al[6] also reported a higher male-to-female ratio of 2.28:1 which coincides with present study.

The mean age for males was 32.9 years while that for females was 32.8 years (Tab. 3). Singh R et al[8] studied 416 patients with an age range of 20 to 65 years reported the mean age for males to be 40.88 years.

Study Comparison	Study population	Male:Female Ratio
Hongsakul K and Laothamatus J	195	1.4:1
Berhe T et al	347	1.02:1
Patel ML et al	105	4.5:1
Oliveira JF et al	194	2.28:1
Present study	60	2.75:1

Table 3

From the present study it is evident that, headache was the most common complaint seen in 41.7% cases followed by altered sensorium (38.3%) and seizures (23.3%). Fever was seen in 18.3% cases while unconsciousness and generalized weakness was seen in 10% cases each. In the study conducted by Hongsakul K and laothamatus J[7] they found that headache was seen in 41.5% of cases, altered sensorium in 33.3% of cases, seizures in 11.8% of cases and motor weakness in 9.7% of cases. While in a study of 347 patients by Berhe T et al[5] the incidence of headache was found to be 61.05%, altered sensorium was seen in 53.89% cases, seizures in 34.29% cases and fever in 31.12% cases. According to Patel ML et al[9] the commonest presenting symptom was fever (72.38%), followed by loss of weight (56.19%), vomiting (28.57), headache (27.62%), altered sensorium (18.1%), paraparesis (1.90%), blurring of vision (1.9%), hemiparesis (1.9%) and quad-riparesis (0.95%).

In the present study, cerebral atrophy was the most common finding seen in 38.33% cases. In patients with AIDS dementia complex, CT showed diffuse, symmetric cerebral atrophy that was out of proportion for the patient's age.[3] In the study conducted by Hongsakul K and Laothamatus J[7] (Fig. 1), 59% cases were diagnosed as having cerebral atrophy suggestive of HIV encephalopathy. In a study of 416 patients by Singh R et al[8] the incidence of HIV associated dementia was found to be 33.65%. In a study of 200 patients by Moller AA et al[10] non-focal atrophic changes was seen in 74 (37%)cases. Levy RM et al[15] studied 200 consecutive patients with AIDS and neurologic symptoms. They found the incidence of diffuse cerebral atrophy in 75 (37.5%) patients. However Deshpande AK et al[11] in a study of 300 cases found the incidence of AIDS

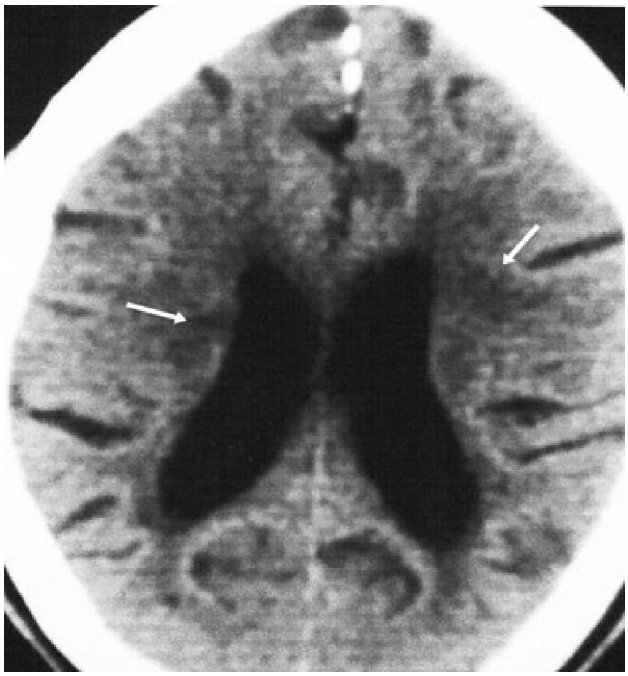

Figure 1: Non contrast axial CT Brain in a 33 year old HIV patient shows diffuse brain atrophy with symmetrical hypodense areas in the deep white matter periventricular in location-PML.

dementia complex in only 5.9% which is significantly lower than the present study. Kim HJ et al[12] studied 34 patients and found the incidence of HIV ence-phalopathy in 29% of cases. Satischandra P et al[13] found the incidence of HIV associate dementia in 15% of cases out of a total 20 cases. Balakrishnan J et al[14] reported that the incidence of HIV ence-phalopathy can be found in 60% of cases.

There was wide variation in the reported incidence of HIV encephalopathy (Tab. 4). However, most of the studies found the incidence value to be in between 30% to 40%. This is similar to the present study (38.33%).

Study Comparison	Incidence of HIV encephalopathy
Hongsakul K and Laothamatus J	59%
Singh R et al	33.65%
Moller AA et al	37%
Levy RM et al	37.5%
Balakrishnan J et al	60%
Kim HJ et al	29%
Deshpande AK et al	5.9%
Present study	38.33%

Table 4

In the present study 15 cases out of total 23 cases of cerebral atrophy was seen in the age group 20-49 years and most of them were male patients (16 cases). Levy RM et al[15] in the study of 200 patients with AIDS and neurologic symptoms too found that patients with initial CT evidence of atrophy only were young patients and the atrophy was related to AIDS and not to normal aging. Post MJ et al[16] studied 22 patients and reported that the median age was 36.5 year and all the patients were men.
In the present study, most of the patients presented with altered sensorium (12 cases) and headache (9 cases). Post MJ et al[6] report that progressive alteration of mental status, confusion, slowness of thought etc. were the clinical findings in HIV encephalitis. Stanley PC et al[17] studied 61 HIV seropositive patients and found that headache and seizures are common in HIV encephalopathy.While in the study by Moller AA et al[10] they found that 89% of the patients with no-focal atrophic changes had no neurological symptoms; 2 patients out of total 74 cases had symptoms and signs of meningism (Fig. 2) and 3 patients had focal cerebral symptoms.

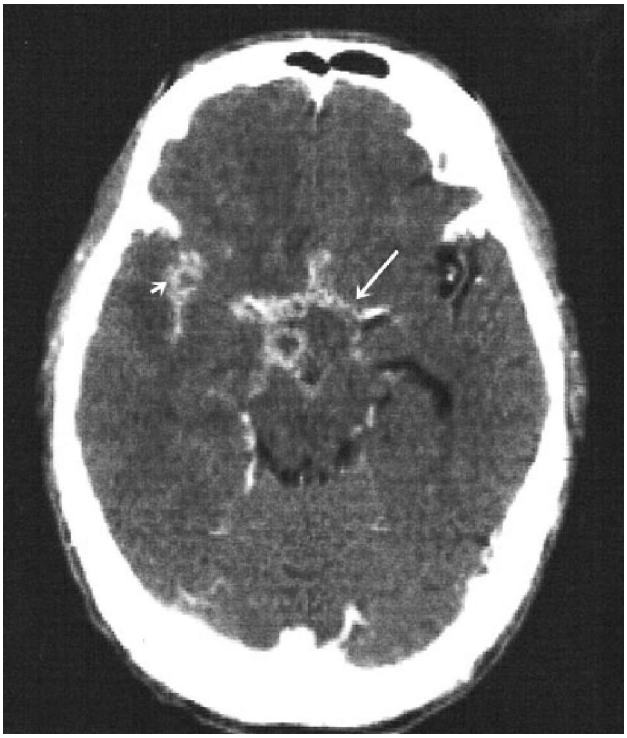

Figure 2: Contrast enhanced axial CT Brain scan shows marked leptomeningeal enhancement in suprasellar cistern, right sylvian fissure and a few of sulcal spaces suggestive of meningitis-Tuberculous?

In the present study out of total 23 cases of atrophy, 4 cases were associated with hydrocephalus. Post MJ et al[16] found that out of 21 patients 13 had hydrocephalus. In total 23 cases of atrophy, hypodense lesions (Fig. 3) were found in 9 cases of which 3 had symmetric diffuse hypodensities. Post MJ et al[16] in their study, found that out of 21 patients with atrophy 7 patients had hypodense lesions and symmetrical hypodense lesions were found in 5 patients only. Hongsakul K and Laothamatus J[7] studied 195 patients out of which 144 patients had atrophy detected by CT. Of these 144 patients, 50 patients had hypodense lesions. So the present study is in accordance with the literature.

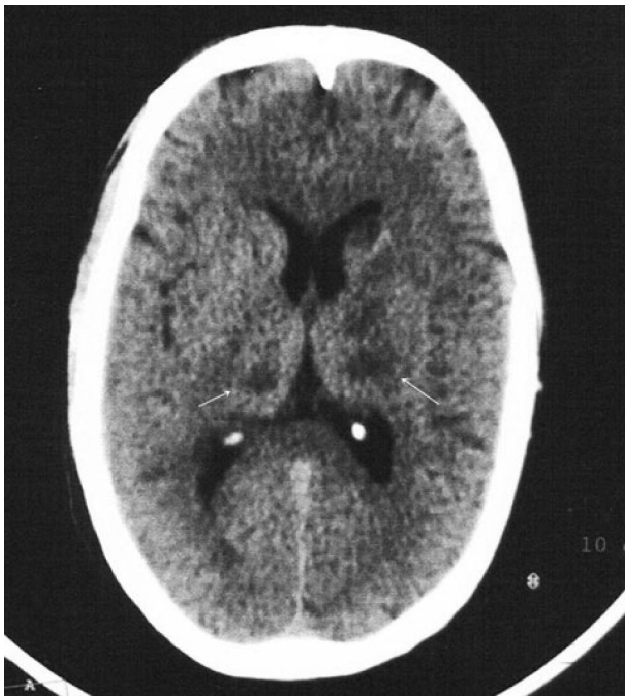

Figure 3: Axial CT scan Brain shows small non enhancing hypodense lesions in bilateral thalamic regions.

In the current study, 33 patients had hypodense lesions of which 7 patients showed ring enhancing pattern of enhancement (Fig. 4) while 6 patients showed no enhancement and one patient had heterogeneous enhancement. Patients with ring enhancing hypodense lesions had headache and seizure in 57.14% of cases. Altered sensorium was seen in 28.57% of cases. Hongsakul K and Laothamatus J[7] reported that the most common CT finding of toxoplasmosis were multiple deep and superficial ring enhancing lesions. In their study

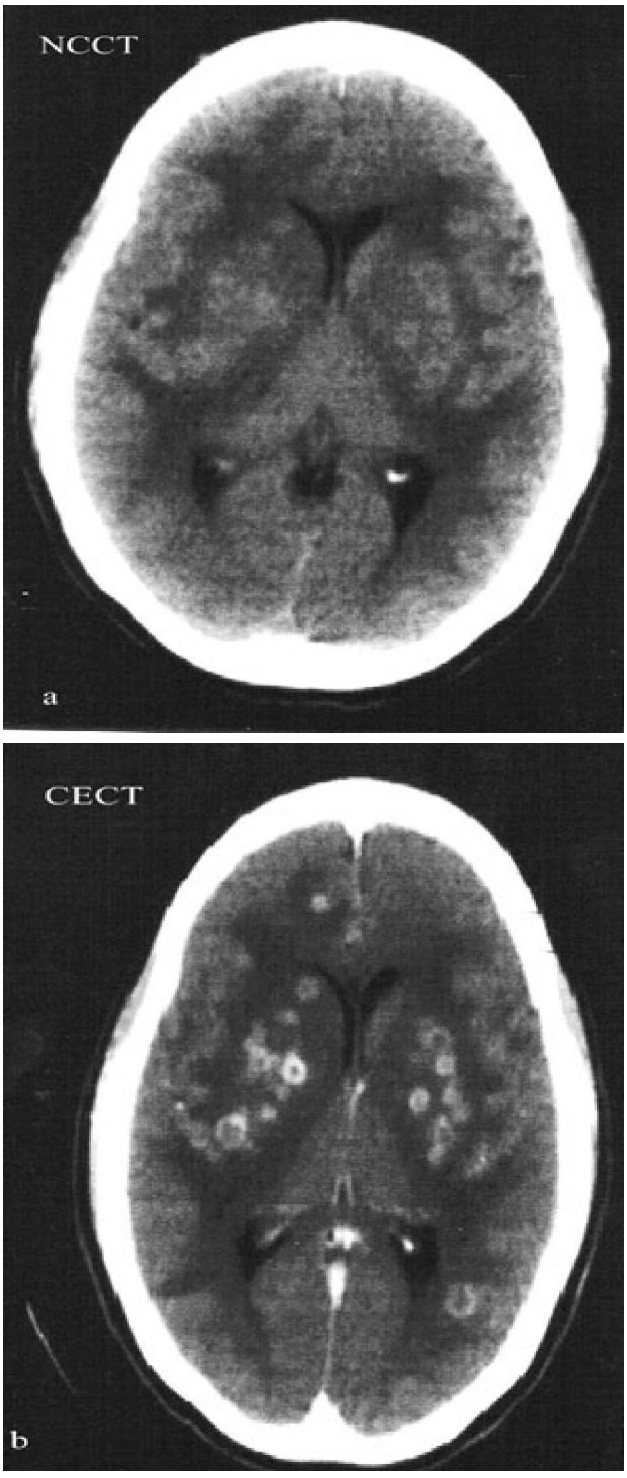

Figure 4(a): Non contrast and (b) contrast enhanced CT Brain axial views showing multiple small ring enhancing lesions with significant perilesional edema.

there was 76% multiple lesions and 24% single lesions. In a study conducted by Satishchandra P et al[13] convulsions and focal neurological deficits were seen in 61.5% of cases. In the study conducted by Berhe T et al[5] headache was seen in 47.2% of cases, altered sensorium was seen in 58.3% of cases and seizures was seen in 42.5% of cases. In the present study single lesion was seen in 71.42% of cases and multiple lesions were seen in 28.57% of cases.

In our study, all the hypodense lesions were located in the supratentorial region. 51.51% of the lesions were located in the basal ganglionic region while 48.48% of them were located in the cerebral hemispheric region. Hongsakul K and Laothamatus J[7] reported that the cerebral hemispheres and basal ganglia are the most common sites for cerebral toxoplasmosis. Cryptococcomas which present as nonenhancing hypodense lesions are also situated in the basal ganglionic region. Progressive multifocal leukoencepholopathy is also seen on CT as asymmetric, nonenhancing hypodense lesion without mass effect in the cerebral hemispheres. Dina TS[18] reported the locations of toxoplasmic lesions to be 17% in basal ganglionic region, 45% in cerebral hemispheres. Infarctions also appear as nonenhancing hypodense lesions.

Intracranial tuberculomas appear either as ring or nodular enhancing hyperdense or isodense lesions (Fig. 5). This pattern was described by Whelan MA and Stern J[19] in eight patients. In their study, prior to administration of contrast material, all lesions

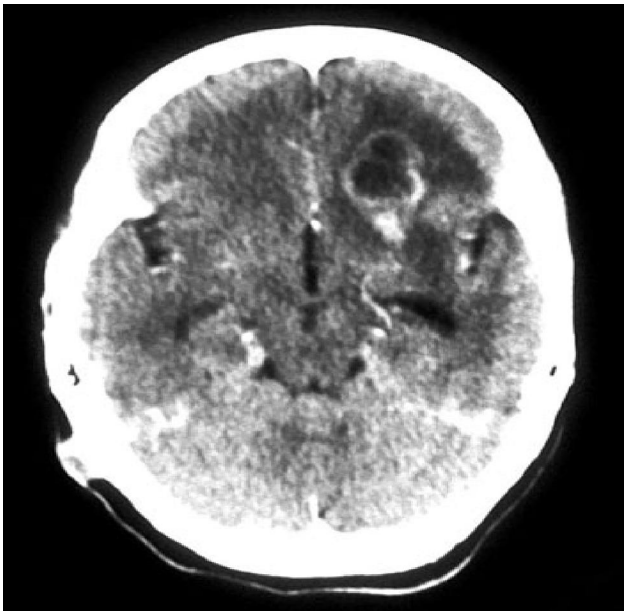

Figure 5: CECT Brain axial scan showing an irregular ring enhancing lesion in left frontal lobe. Marked peripheral edema with effacement of adjacent sulcogyral spaces- Cerebral Tuberculoma.

were either isodense or minimally hyperdense, and none were calcified. Four patients showed ring enhancing pattern while 6 patients had the nodular enhancement pattern. Perilesional edema with supratentorial location was noted in 7 cases while one was located infratentorially. In the present study, 4 patients had hyperdense lesion and 3 patients had isodense lesions. Of these 7 cases, 4 of them had lesions supratentorially while 3 had lesions infratentorially. Mass effect was seen in 6 of the cases. Heterogeneous pattern of enhancement was seen in 4 cases, ring enhancing pattern in one cases and homogeneous enhancement in one case. In the study by Whelan MA et al[19], 3 patients presented with seizures, 2 with headache and fever, altered sensorium, neck rigidity were seen in 1 cases each. In the present study, headache and seizures were seen in 3 cases each, unconsciousness in 2 cases and altered sensorium, fever in 1 case each. One of the hyperdense lesion which showed homogeneous enhancement, mass effect and was located infratentorially had features similar to meningioma (Fig.5). Meningiomas are the most common non-glial primary tumors of the central nervous system and the most common extra axial neoplasms, accounting for approximately 15% of all intracranial tumors. The typical meningioma is a homogeneous, hemispheric, markedly enhancing extra axial mass located over the cerebral convexity, in the parasagittal region, or arising from the sphenoid wing.[20]

In the present study, a case with an isodense lesion with calcification and heterogeneous enhancement located infratentorially was seen, the features of which were suggestive of ependymoma. Ependymomas are isodense of on non-enhanced CT, approximately 50% show calcification and mild to moderate inhomogeneous enhancement is seen and 60% of them located infratentorially.[21] These findings emphasize the need for routine CT scanning with or without intravenous contrast agent in HIV patients with neurologic symptoms and signs as it is a very good initial investigation to rule out any neurological involvement. Clinical judgment alone is not sufficient for detecting neurological involvement in HIV patients.

Conclusions

CT scan of brain remains an essential imaging study in HIV patients with clinical signs and symptoms of neurological involvement. It is widely available, simple to perform and can be performed quickly on confused, delirious patients. Clinical diagnosis is often not possible in these patients because of considerable overlap in the signs and symptoms. CT scan must be done which can effectively demonstrate any neurological involvement. In fact a normal CT scan of the brain has been shown to be associated with a better prognosis in relation to the development of progressive neurological disease. So the CT scan of the brain in HIV infected individuals with neurological symptoms and signs can provide the clinician with diagnostic as well as prognostic information for a better patient management.

References

1. Fauci AS, Lane HC. Human immunodeficiency virus disease: AIDS and related disorders. In: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J (editors). Harrison's Principles of Internal Medicine. 18th ed. New York: McGraw Hill Medical 2012; 1506-87.

2. Bakshi R. Neuroimaging of HIV and AIDS related illness: review. Front Biosci 2004; **1(9):** 632-46.

3. Smith AB, Smirniotopoulos JG, Rushing EJ. Central nervous system infections associated with human immunodeficiency virus infection: radiologic-pathologic correlation. Radiographics 2008; **28:** 2033-58.

4. Post MJ, Kursunoglu SJ, Hensley GT, Chan JC, Moskowitz LB, Hoffman TA. Cranial CT in acquired immunodeficiency syndrome: spectrum of diseases and optimal contrast enhancement technique. Am J Roentgenol 1985; **145:** 929-40.

5. Berhe T, Melkamu Y, Amare A. The pattern and predictors of mortality of HIV/AIDS patients with

neurologic manifestation in Ethiopia: a retrospective study. AIDS Res Ther 2012; **9:** 11-7.

6. Oliveira JF, Greco DB, Oliveira GC, Christo PR, Guimaraes MDC, Correa-Oliveria R. Neurological disease in HIV infected patients in the era of highly active antiretroviral treatment: a Brazilian experience. Rev Soc Bras Med Trop 2006; **39(2):** 146-51.

7. Hongsakul K, Laothamatas J. Computer tomographic findings of the brain in HIV patients at Ramathibodi Hospital. J Med Assoc Thai 2008; **91(6):** 895-907.

8. Singh R, Kaur M, Arora D. Neurological complications in late stage hospitalized patients with HIV disease. Ann Indian Acad Neurol 2011; **14(3):** 172-7.

9. Patel ML, Sachan R, Atam V, Chaudhary SC, Gupta A. Various neurological manifestations in HIV positive patients, their outcome and its correlation with CD4 counts - a tertiary centre experience in north Indian population. J AIDS HIV Res 2012; **4(7):** 198-202.

10. Moller AA, Backmund H. CT findings in different stages of HIV infection: a prospective study. J Neurol 1990; **237:** 94-7.

11. Deshpande AK, Patnaik MM. Nonopportunistic neurologic manifestations of the human immunodeficiency virus: an Indian study. J Int AIDS Soc 2005; **7:** 2-11.

12. Kim HJ, Kim SY, Lee KB, Lee KW, Oh M, Choe K. Neurologic complications of human immunodeficiency virus type 1 infection. J Korean Med Sci 2003; **18:** 149-57.

13. Satishchandra P, Nalini A, Gourie-Devi M, Khanna N, Santosh V, Ravi V et al. Profile of neurologic disorders associated with HIV/AIDS from Bangalore, south India (1989-96). Indian J Med Res 2000; **111:** 14-23.

14. Balakrishnan J, Becker PS, Kumar AJ, Zinreich SJ, McArthur JC, Bryan RN. Acquired immunodeficiency syndrome: correlation of radiologic and pathologic findings in the brain. Radiographics 1990; **10:** 201-15.

15. Levy RM, Rosenbloom S, Perrett LV. Neuroradiologic findings in AIDS: a review of 200 cases. Am J Roentgenol 1986; **147:** 977-83.

16. Post MJ, Tate LG, Quencer RM, Hensley GT, Berger JR, Sheremata WA et al. CT, MR and pathology in HIV encephalitis and meningitis. Am J Roentgenol 1988; **151:** 373-80.

17. Stanley PC, Asekomeh EG, Stanley CN. Pattern of neurological disorders among HIV seropositive adult Nigerians with psychiatric morbidity. Res J Med Sci 2007; **1(4):** 219-22.

18. Dina TS. Primary central nervous system lymphoma versus toxoplasmosis in AIDS. Radiology 1991; **179:** 823-8.

19. Whelan MA, Stern J. Intracranial tuberculoma. Radiology 1981; **138:** 75-81.

20. Buetow MP, Buetow PC, Smirniotopoulos JG. Typical, atypical and misleading features in meningioma. Radiographics 1991; **11:** 1087-106.

21. Osborne AG. Diagnostic neuroradiology. Missouri: Mosby; 1994, Ch. 13, Astrocytomas and other glial neoplasms; 568-9.