

## นิพนธ์ต้นฉบับ

# Accuracy of Computed Tomography for Common Neurological Disease in HIV Patients at Siriraj Hospital

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## Abstract

**Objectives:** For evaluation accuracy of Computed Tomography (CT) for diagnosis common neurological disease in HIV patient at Siriraj hospital.

**Materials and Methods:** Our study corrected CT brain images of 139 HIV patients in Siriraj hospital since 2008 to 2013. Using the image data of CT brain in pre-contrast and post-contrast for diagnosis common neurological disease in HIV patients. Accuracy of study was done by using data correlation between imaging and blood histochemistry laboratory data. The accuracy of computed tomography was calculated for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV).

**Results:** The study population included of 93 males and 46 females. The patients' age ranged from 10 to 71 years. Common neurological disease in HIV patients were Cryptococcal meningitis (46 patients, 32.6%), followed by TB meningitis (45 patients, 32.4%), HIVE (37 patients, 26.6%), Toxoplasmosis (20 patients, 14.4%), PML (13 patients, 9.4%), PCNSL (9 patients, 6.5%), Other (Brain metastasis, Intracerebral hemorrhage, Meningitis and Kaposi sarcoma) (5 patients, 3.6%), Tuberculomas (4 patients, 2.9%), and Cryptococcomas (3 patients, 2.2%), respectively. Accuracy of common neurological disease was 68.3, 74.1, 56.8, 89.0, 93.5, 97.8, 96.4, 92.8 and 96.4 respectively. CT was found the most accuracy to have sensitivity, specificity, PPV and NPV for PCNSL (77.8%, 99.2%, 85.7% and 98.5%), respectively.

**Conclusion:** Cryptococcal meningitis, Tuberculous meningitis and HIVE were common neurological disease to have high prevalence in all 139 HIV patients. The most accuracy of CT was showed with spaceoccupying lesion such as PCNSL, Toxoplasmosis, Tuberculomas and Cryptococcomas followed by PML and Meningitis.

**Keywords:** *Computed Tomography, Common neurological disease, HIV patients*

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## Introduction

The human immunodeficiency virus (HIV) is a retrovirus that infects cells of the immune system and destroys or disrupts their function. In the more advanced stages of HIV infection, it will be developed to acquired immunodeficiency syndrome (AIDS). The World Health Organization reported that there were 31.4-33.5 million AIDS-patients worldwide in 2006. In 2008, AID was the problem 6th of all disease and found the mortality about 1.78 million people worldwide. The last report in 2012 estimated more than 35.3 million people worldwide. In Thailand, there were 372,874 people of all AIDS-patients and were died 98,153 people in September 1984 to December 2011. The age of patients ranged from 5 to 60 years and the most age of 25 to 40 years<sup>1</sup>.

The Central Nervous System (CNS) is the most target of the human immunodeficiency virus (HIV). HIV can lead to CNS by crosses the blood brain barrier (BBB) at an early stage of the disease. Up to 60% of AIDS patients will have neurologic manifestation which will be the first clinical manifestation of AIDS patients about 10% of cases<sup>2</sup>. Common neurological diseases are classified into direct infection and indirect infection. The direct infection is result from HIV- itself includes HIV encephalopathy (HIVE) that caused AIDS-dementia, becoming the most frequent neurologic complication of HIV infection. The indirect infections are opportunistic infection and malignancies include Toxoplasmosis, Cryptococcal meningitis, Cryptococcomas, Tuberculous meningitis, Tuberculomas, Progressive multifocal leukoencephalopathy (PML) and Primary CNS lymphoma (PCNSL)<sup>3</sup>.

Laboratory presentation in HIV-patients was showed anti-HIV, Standard test for Cerebrospinal fluid (CSF) in-

clude CSF protein, sugar and cell count but the tests are nonspecific. Although, CSF-antigen, Polymerase chain reaction (PCR), and CSF culture have high specificity, but low sensitivity. In addition, brain biopsy is an invasive procedure and risk for personnel. This procedure is limited. Moreover, the CD4+ T lymphocytes are the best predictor at all stages of diseases. The patient is immunity weak when the CD4 counts  $<200$  cells/mm<sup>3</sup>. Immunological staging of HIV are most frequently defined:  $<200$  cells/mm<sup>3</sup>,  $200-500$  cells/mm<sup>3</sup> and  $\geq 500$  cells/mm<sup>3</sup>. As clinical symptoms may be nonspecific and laboratory testing is often unhelpful. Nevertheless, radiological interpretation still relies for diagnosis, the exclusion of occult pathology and follow up, and monitoring of therapy. As CT is a choice for diagnosis, even though, its sensitivity of lesion detection has not the same as MRI. However, CT has various advantages such as low cost, safe and more widespread, whereas other imaging modalities i.e. Magnetic Resonance Imaging (MRI), Single-Photon Emission Computed Tomography (SPECT), and Positron Emission Tomography (PET) but they are not widespread at the present.

## Material and Method

The patients were identified from The International Classification of Disease (ICD 10). The study was retrospective study by all patients that were available in assessment of both CT imaging of the brain in PACS workstation in Siriraj hospital and reviewed by two neuro-radiologists. Our study corrected CT brain images of 139 HIV patients in Siriraj hospital since 2008 to 2013. Using the image data of CT brain in pre-contrast and post-contrast for diagnosis common neurological disease in

HIV-patients have seropositive of HIV Accuracy of the study was done by using data of both CT imaging and medical record.

The CT scan was performed with multidetector CT scanner (Light speed 16; General Electric Medical System, Milwaukee, Wisconsin, USA). Technique: 120 kV, 250 mA, and 5-mm section thickness. Coverage was from the skull base to the vertex by obtaining contiguous axial.

1. Baseline characteristic of the present were summarized in terms of frequency and percentages.

2. Agreements between interpretations of two neuroradiologists were calculated with the Cohen \*kappa test.

Poor agreement = Less than 0.20

Fair agreement = 0.20 to 0.40

Moderate agreement = 0.41 to 0.60

Good agreement = 0.61 to 0.80

Very good agreement = 0.81 to 0.9

3. The result was analyzed from table 2\*2 by using Microsoft Excel (Microsoft, 2010) and SPSS version 18. The accuracy of CT was calculated for sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV).

### 2.1 Interpretation

The imaging interpretation were done by two neuroradiologists. Interestingly, some lesions from CT scan cannot classify the neurological disease. Accordingly, each diseases were reviewed for the following findings:

1. HIVE represented normal or atrophy, hypodense and no mass effect and non-enhancing.

2. Toxoplasmosis represented multiple hypo-

dense/isodense lesions with surrounding edema and mass effect and thin, smooth rim or solid nodular enhancement surrounding edema and mass effect.

3. PML represented multifocal, hypodense without mass effect or edema and non-enhancing.

4. PCNSL represented isodense, hyperdense or hypodense ring-shaped, irregular and sometimes homogenous or rim enhancement.

5. TB meningitis represented isodense to hyperdense and leptomeningeal enhancement.

6. Tuberculomas represented ring/nodular enhancing masses and edema and mass effect.

7. Cryptococcal meningitis represented isodense to hyperdense and leptomeningeal enhancement.

8. Cryptococcomas represented a solid or ring enhancement parenchymal mass with surrounding edema and hydrocephalus.

## Results

One hundred fifty nine patients had seropositive for HIV but twenty of all HIV patients were excluded for absent or poor data. Therefore, the study had all total 139 patients whose clinical data and result of laboratory test had proven their HIV status as positive. All 139 patients presented clinical manifestations and underwent CT at Siriraj hospital from 2008 to 2013. The study of population included 93 males and 46 females with male-to-female ratio of 2:1. The age of the patients ranged from 9 to 71 years with the mean age of  $38.6 \pm 11.3$  years. The three most of the patients were adult (range 21 to 60 years) including twenty-five patients (18%) were aged 21 to 30 years, seventy-six patients (54.7%) were aged 31 to 45 years and twenty-nine patients (20.9%)

were aged 46 to 60 years

**3.1 Laboratory investigation**

The HIV patients majority of CD4-count < 200 cells/mm<sup>3</sup> were one hundred twenty-eight patients (92.08%) with mean CD4-count was 50 cells/mm<sup>3</sup> (range 1- 656 cells/ μl) (Table 2). The majority of white blood cells were 3,000-10,000 cell/mm<sup>3</sup> and the mean of white blood cells was 5,630 cell/mm<sup>3</sup> (range 960-183,000 cell/mm<sup>3</sup>).

**3.2 Clinical manifestations**

All 139 HIV patients with the neurological disease, the most common presenting neurological symptom was headache (100 patients, 65.5%), followed by weakness (75 patients, 53.96%), nausea/vomiting (58 patients, 41.73%), altered consciousness (55 patients, 39.57%), blurred vision (37 patients, 26.62%), stiff neck (29 patients, 20.86%), seizures (27 patients, 19.42%), ataxia (20 patients, 14.39%), diplopia (10 patients, 7.19%) and numbness (2 patients, 1.44%) (Table 4). Furthermore, the extra-neurological symptom was fever (102 patients, 73.38%), followed by cough (53 patients, 38.13%), weight loss (48 patients, 34.53%), skin rash (15 patients, 10.79%), diarrhea (8 patients, 5.76%), abdominal pain (6 patients, 4.32%), dyspnea (2 patients, 1.44%), chills (2 patients, 1.44%) and tremble (2 patients, 1.44%).

**3.3 HIV associated common neurological diseases**

All 139 HIV patients associated common neurological diseases. Most common disease was Cryptococcal meningitis (46 patients, 32.6%), followed by TB meningitis (45 patients, 32.4%), HIVE (37 patients, 26.6%), Toxoplasmosis (20 patients, 14.4%), PML (13 patients, 9.4%), PCNSL (9 patients, 6.5%), Other (Brain metastasis, Intracerebral hemorrhage, Meningitis and Kaposi sar-

coma) (5 patients, 3.6%), Tuberculomas (4 patients, 2.9%), and Cryptococcomas (3 patients, 2.2%). The most patients had more than one disease

**3.4 Interpretation with computer tomography by calculated statistic**

3.4.1 Interobserver agreement

The CT-finding was presented by two neuroradiologists. It was calculated with Kappa. Interpretation for Cryptococcal meningitis was good agreement (K=0.7), TB meningitis was good agreement (K=0.7), HIVE was moderate agreement (K=0.5), Toxoplasmosis was good agreement (K=0.7), PML was good agreement (K=0.8), PCNSL was very good agreement (K=0.9), Tuberculomas was moderate agreement (K=0.6), Other (Brain metastasis, Intracerebral hemorrhage, Meningitis and Kaposi sarcoma) were moderate agreement (K=0.5) and interpretation of Cryptococcomas was fair agreement (K=0.4).

3.4.2 Calculated statistic for accuracy of computer tomography

**Table 1** Prevalence of common neurological diseases of 139 HIV-patients from 2008 to 2013 at Siriraj hospital.

Common neurological diseases	Number (%)
Cryptococcal meningitis	46 (33.1)
Tuberculous meningitis	45 (32.4)
HIVE	37 (26.6)
Toxoplasmosis	20 (14.4)
PML	13 (9.4)
PCNSL	9 (6.5)
Other	5 (3.6)
Tuberculomas	4 (2.9)
Cryptococcomas	3 (2.2)

**Table 2** Agreement between interpretations of two neuroradiologists for common neurological diseases (139 patients).

Common neurological disease	Neurological 1 and Neurological 2				Kappa
	A	B	C	D	
	(+ +)	(+ -)	(- +)	(- -)	
Cryptococcal meningitis	34	7	12	86	0.7
Tuberculous meningitis	21	10	2	106	0.7
HIVE	63	3	26	47	0.6
Toxoplasmosis	26	9	7	97	0.7
PML	18	4	1	116	0.8
PCNSL	8	1	0	130	0.9
Tuberculomas	5	1	5	128	0.6
Other	9	6	9	115	0.5
Cryptococcomas	2	0	6	131	0.4

Cryptococcal meningitis was diagnosed in 34 patients by CT and 46 patients in medical record. There were 18 patients of true positive and false negative in 28 patients including 17 HIVE, 4 TB meningitis, 3 PML combined with HIVE, 1 PML, 1 Toxoplasmosis, 1 Tuberculomas and 1 Toxoplasmosis combined Tuberculomas. The Specificity, Sensitivity, PPV, NPV and Accuracy of Cryptococcal meningitis was 82.8%, 39.1%, 52.9%, 73.3% and 68.3% respectively (Table 3). TB meningitis was diagnosed 21 patients by CT and 45 patients medical record. There were 15 patients of true positive and 30 patients of false negative including 10 HIVE, 8 Cryptococcal meningitis, 5 HIVE combined with Cryptococcal meningitis, 2 Toxoplasmosis, 2 Other (Meningitis pattern), 1 Toxoplasmosis combined with Cryptococcomas and Cryptococcal meningitis, 1 Tuberculomas and 1 PML. Seven patients of false positive were 6 Cryptococcal meningitis. The Specificity, Sensitivity, PPV, NPV and Accuracy of TB meningitis was 93.6%, 33.3%, 71.4%, 74.6% and 74.1% respectively (Table 3). HIVE was diag-

nosed in 63 patients by CT and 37 patients in medical record. There were 20 patients of true positive and false negative in 17 patients including 7 Toxoplasmosis, 3 other (Meningitis pattern), 3 TB meningitis, 2 Cryptococcal meningitis, 1 PML and 1 Tuberculomas. The Specificity, Sensitivity, PPV, NPV and Accuracy of HIVE were 57.8%, 54.1%, 31.7%, 77.6% and 56.8% respectively (Table 3). Toxoplasmosis was diagnosed 26 patients by CT and 20 patients in medical record. There were 16 patients of true positive and 4 patients of false negative including 1 HIVE, 1 PML, 1 HIVE combined with PML and 1 HIVE combined with Cryptococcal meningitis. The Specificity, Sensitivity, PPV, NPV and Accuracy of Toxoplasmosis was 91.6%, 80.0%, 61.5%, 96.5% and 89.9 % respectively (Table 3). PML was diagnosed 18 patients by CT and 13 patients in medical record. There were 11 patients of true positive and 2 patients of false negative including 2 HIVE. The Specificity, Sensitivity, PPV, NPV and Accuracy of PML were 94.4%, 84.6%, 61.1%, 98.3% and 93.5% respectively (Table 3). PCNSL was diagnosed

8 patients by CT and 9 patients in medical record. There were 7 patients of true positive and 2 patients of false negative including 2 Toxoplasmosis. The Specificity, Sensitivity, PPV, NPV and Accuracy of PCNSL was 99.2%, 77.8%, 87.5%, 98.5% and 97.8% respectively (Table 3). Tuberculomas was diagnosed 5 patients by CT and 4 patients in medical record. There were 2 patients of true positive and 2 patients of false negative including 2 Toxoplasmosis. Three patients of false positive were 2 Cryptococcal meningitis and 1 TB meningitis. The Specificity, Sensitivity, PPV, NPV and Accuracy of Tuberculomas was 97.8%, 50.0%, 40%, 98.5% and 96.4% respectively (Table 3). The others were diagnosed 9 patients by CT and 5 patients in medical record. There were 2 patients of true positive and 3 patients of false negative. The Specificity, Sensitivity, PPV, NPV and Accuracy of the others was 95.8.1%, 40.0%, 22.2.0%, 97.8% and 92.8.0% respectively (Table 3). Cryptococcomas was diagnosed 2 patients by CT and 2 patients in medical record.

There was 0 patient of true positive and 2 patients of false negative including 2 Tuberculomas. The Specificity, Sensitivity, PPV, NPV and Accuracy of Cryptococcomas was 98.5%, 0%, 0%, 97.8% and 96.4% respectively (Table 3).

### Discussion

HIV associated common neurological diseases are an important disease for health problem and may lead the high mortality. Up to 60% of all HIV patients will be developed common neurological diseases<sup>23</sup>. HIV patient can be appearance of various diseases and often are diagnosed with imaging in order to find out a real cause. Therefore, Computer tomography (CT) is a choice of diagnosis.

The present study shows male to female with ratio of 2:1 and the mean age of 38.6±11.3 years. Most CD4 count was less than 200 cells/mm<sup>3</sup> (128 patients, 92.9%) with the median CD4 count of 50 cells/ mm<sup>3</sup> (range 1-

**Table 3** PPV, NPV, Sensitivity, Specificity and Accuracy of Computedtomography for interpretation in 139 HIV patients TP = True positive TN = True negative FN = False negative FP = False positive PPV = Positive predictive positive value NPV = Negative predictive value

Common neurological disease	CT/ final diagnosis				CT pattern				
	TP (no.)	TN (no.)	FP (no.)	FN (no.)	PPV (95% CI)	NPV (95% CI)	Sensitivity (95% CI)	Specificity (95% CI)	Accuracy (95% CI)
Cryptococcal meningitis	18	77	16	28	52.9(35.4-69.8)	73.3(63.6-81.3)	39.1(25.4-54.6)	82.8(73.2-89.5)	68.3
TB meningitis	15	88	6	30	71.4(47.7-87.8)	74.6(65.6-81.9)	33.3(20.4-49.1)	93.6(86.1-97.4)	74.1
HIVE	20	59	43	17	31.7(20.9-44.8)	77.6(66.3-86.1)	54.1(37.1-70.2)	57.8(47.7-67.4)	56.8
Toxoplasmosis	16	109	10	4	61.5(40.7-79.1)	96.5(90.6-98.9)	80.0(55.7-93.4)	91.6(84.7-95.7)	89.9
PML	11	119	7	2	61.1(36.1-81.7)	98.3(93.6-99.7)	84.6(53.7-97.3)	94.4(88.5-97.5)	93.5
PCNSL	7	129	1	2	87.5(56.0-98)	98.5(95.0-99.6)	77.8(45.3-93.7)	99.2(95.8-99.9)	97.8
Tuberculomas	2	132	3	2	40.0(7.2-82.9)	98.5(94.2-99.7)	50.0(9.1-90.8)	97.8(93.1-99.4)	96.4
Other	2	127	7	3	22.2(3.9-59.8)	97.7(92.9-99.4)	40.0(7.2-82.9)	94.8(89.1-97.7)	92.8
Cryptococcomas	0	134	2	3	0.0(0.0-80.2)	97.8(93.2-99.4)	0.0(0.0-69.0)	98.5(94.2-99.7)	96.4

656 cells/ mm<sup>3</sup>). However, HIV patients with less than 200 cells/mm<sup>3</sup> will be developed certain opportunistic infection<sup>24</sup>. Therefore, this range is found about 50-70% and is the highest risk in the patients. If they did not receive antiretroviral therapy, they would have CD4 count of less than 50 cells/mm<sup>3</sup> and show of common neurological diseases within 2 years<sup>25</sup>.

The prevalence of the present study in 139 HIV patients associated common neurological diseases of Cryptococcal meningitis (46 patients, 32.6%), TB meningitis (45 patients, 32.4%), HIVE (37 patients, 26.6%), Toxoplasmosis (20 patients, 14.4%), PML (13 patients, 9.4%), PCNSL (9 patients, 6.5%), Other (Brain metastasis, Intracerebral hemorrhage, Meningitis and Kaposi sarcoma) (5 patients, 3.6%), Tuberculomas (4 patients, 2.9%), and Cryptococcomas (3 patients, 2.2%) in period 2008 to 2013 at Siriraj hospital. There were many author about HIV patients associated common neurological diseases such as, the study of Maslah E et al, who reviewed brain 390 AID patients in period 1982 to 1998. The result showed HIVE 26.3%, CMV 22.3%, Toxoplasmosis 2.51%, PML 2.9% and non-hodgkins'lymphoma 8.4%. The study of Steinmetz H et al reviewed brain 188 HIV patients in period 1988 to 1991. The result showed cerebral Toxoplasmosis 25%, HIVE 10.1%, PML 4.8%, cerebral Lymphoma 0.5% and other conditions 4.8%. From, the report of Thailand, a retrospective study of Ramathibodi hospital reviewed 195 HIV patients in period 2001-2005. The result showed HIVE 59%, Toxoplasmosis 22%, Cryptococcomas 9%, Tuberculous meningitis 5%, Tuberculomas 4%, PML 3%, Lymphoma 2% and normal 1%. And the retrospective study of King Chulalongkorn Memorial Hospital reviewed 148 HIV-patients in period

2007-2008. The result showed Cryptococcal meningitis (56 patients, 37.8%), followed by tuberculosis (53 patients, 35.8%), toxoplasmosis (19 patients, 12.8%), progressive multifocal leukoencephalopathy (6 patients, 4.1%), varicella-zoster virus (VZV) meningitis (4 patients, 2.7%), brainabscess (3patients, 2.1%), cytomegalovirus radicu-lomyelitis (2 patients, 1.4%), pneumococcal meningitis (2 patients, 1.4%), herpes simplex encephalitis, Epstein-Barr virus-related primary CNS lymphoma, and HIV-associated myelopathy (1 patient, 1 patient, 0.7%). However, those reports found difference of common neurological diseases in each report causing from the prevalence of HIV patients in difference area and period of collecting data.

Cryptococcal meningitis is the most common neurological disease from opportunistic infection causing meningitis pattern. In the report<sup>16</sup>, Cryptococcus infection is the third most common cause of CNS infection in AIDS patients. A characteristic pattern shows isodense to hyperdense and Leptomeningeal enhancement<sup>12</sup> being also seen meningitis involvement. However, CT could not identify real cause of meningitis form. However, Cryptococcal meningitis, there were 17 cases of HIVE and 4 cases of TB meningitis being false negative. As, the Specificity, Sensitivity, PPV and NPV was 82.8%, 39.1%, 52.9% and 73.3% respectively (Table 3). For Cryptococcomas shows a solid or ring enhancement parenchymal mass with surrounding edema and hydrocephalus<sup>12</sup>. There were 2 cases of Tuberculomas being false negative. The Specificity, Sensitivity, PPV and NPV of the others was 98.5%, 0%, 0% and 97.8% respectively (Table 3). For, TB meningitis can occur in 5-10% of TB patients with HIV infection which are compared with 2-5% of TB

patients without HIV infection<sup>18</sup>. The TB shows isodense to hyperdense and Leptominogial enhancement<sup>12</sup>, which seems Cryptococcal meningitis. The study had 10 cases of HIVE and 8 Cryptococcal meningitis being false negative. The Specificity, Sensitivity, PPV and NPV was 93.6%, 33.3%, 71.4% and 74.6% respectively (Table 3). However, Tuberculomas shows ring/nodular enhancing with surrounding edema and mass effect<sup>12</sup>. Furthermore, when CT shows ring enhancement pattern, it could not be difficult to identify in brain abscess. The present had 2 cases of Toxoplasmosis being false negative. In the study had associated finding with ring enhancement confirmed by brain biopsy. There was Specificity, Sensitivity, PPV and NPV of Tuberculomas (97.8%, 50.0%, 40% and 98.5% respectively) (Table 3). For PML is cause from the papova virus. The incidence of PML with AIDS patients is about 3%-7% of all patients and can be found in childhood and adults. The PML shows hypodense lesions of the white matter with no mass effect and non-enhancement<sup>12</sup>. There was Specificity, Sensitivity, PPV and NPV (94.4%, 84.6%, 61.1% and 98.3% respectively). And there were 2 cases of HIVE being false negative by CT (Table 3). However, CT could be used for both diagnosis and exclusion of the disease. The Toxoplasmosis is the most common cause of focal brain lesions in 3-40% of patients. A characteristic shows single lesion or multiple lesions with surrounding edema, with contrast shows ring enhancement and size < 4 cm.<sup>12</sup>. There was Specificity, Sensitivity, PPV and NPV (91.6%, 80.0%, 61.5% and 96.5% respectively) (Table 3). The incidence of AIDS patient with PCNSL is about 5%. It can appear both HIV patients and non-HIV patients but the risk of HIV patients was more than in non-HIV pa-

tients. CT finding shows single or multiple hypodense lesions, with contrast shows homogenous, ring enhancing and mass effect with size > 4 cm and surrounding edema<sup>12</sup>. There was high Specificity, Sensitivity, high PPV and NPV of PCNSL (99.2%, 77.8%, 87.5% and 98.5% respectively). However, CT may be difficult to identify between Toxoplasmosis and PCNSL. The present, there were 2 cases of Toxoplasmosis being false negative. In the study had associated finding with ring enhancement confirmed by brain biopsy (Table 3). Finally, HIVE is the primary infection of CNS causing of AIDS-dementia or subcortical dementia. HIVE occur later stages of HIV infection. The incidence of HIVE is about 10-30% of AIDS patients. On image shows normal or atrophy (usually can find in adult patient with age more than 60 years), hypodense and no mass effect and non-enhancing and may be overlap with other the diseases. In the present, there was Specificity, Sensitivity, PPV and NPV for HIVE (57.8%, 54.1%, 31.7% and 77.6% respectively) (Table 3).

Moreover, the present study for accuracy of cranial computer tomography for Cryptococcal meningitis, TB meningitis, HIVE, Toxoplasmosis, PML, PCNSL, Tuberculomas, Other (Brain metastasis, Intracerebral hemorrhage, 2 Meningitis and Kaposi sarcoma) and Cryptococcomas was 68.3, 74.1, 56.8, 89.0, 93.5, 97.8, 96.4, 92.8 and 96.4 respectively. The most accuracy of CT was focal neurological diseases such as PCNSL (97.8%), PML (93.5%), Tuberculomas (96.4%) and Cryptococcomas (96.4%) and Toxoplasmosis (89.0%) followed by HIVE (56.8%) and Meningitis pattern.

Therefore, the limitation of this study is Brain abscess shows ring enhancement which it may be con-



fused between Toxoplasmosis, Tuberculomas and Cryptococcomas. They will confirmed by laboratory test such as, brain biopsy. For meningitis pattern cannot identify cause of each disease in some patients. It has just showed with leptomenigeal enhancement for helpful to diagnosis meningitis pattern. Moreover, some of the patients have combine with HIVE resulting do not separate opportunistic infection and HIVE as CT cannot identify cause of the disease. However, it can useful for primary diagnosis.

## Conclusion

The most accuracy was PCNSL (97.8%), followed by, Tuberculomas (96.4%), Cryptococcomas (96.4%), PML (93.5%), Toxoplasmosis (89.9%), TB meningitis (74.1%), Cryptococcal meningitis (68.3%) and HIVE (56.8%). The most of prevalence was Cryptococcal meningitis (46 patients, 33.1%), followed by TB meningitis (45 patients, 32.4%), HIVE (37 patients, 26.6%), Toxoplasmosis (20 patients, 14.4%), PML (13 patients, 9.4%), PCNSL (9 patients, 6.5%), Other (Brain metastasis, Intracerebral hemorrhage, Meningitis and Kaposi sarcoma) (5 patients, 3.6%), Tuberculomas (4 patients, 2.9%), and Cryptococcomas (3 patients, 2.2%) However, if they are treated with Highly Active Antiretroviral Therapy (HAART), they will have decrease mortality. Therefore, this study has just found the correct diagnosis of each disease in order to lead more efficiency of treatment.

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