

# 1 Computed Tomography Examination Reveals Brain Lesions in 2 Guangzhou AIDS Patients

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## 7 **Abstract**

8 Cranial computed tomography (CT) plays an important role in the diagnosis of AIDS.  
9 However, our understanding of the CT scan images on the diagnosis or evaluating treatment  
10 results has not yet been completed. In this study, we conducted an investigation on the  
11 usefulness of cranial CT examination in diagnosing HIV patients. Among them, 34 AIDS  
12 patients tested positive for brain lesions indicated by cranial CT scan examination. Patients  
13 who had AIDS with brain lesions were primarily diagnosed with tuberculous meningitis  
14 (TBM), HIV encephalitis (HIVE), cerebral toxoplasmosis (CT) and cryptococcal meningitis  
15 (CM). Furthermore, we thoroughly compared the characteristics of various brain lesions in CT  
16 images so that it could be helpful for future diagnoses and treatment evaluations of AIDS with  
17 brain lesions. Additionally, we demonstrated that a count of less than 50 CD4+ T  
18 lymphocytes primarily occurred in the TBM and HIVE groups, thus resulting in higher  
19 mortality.

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21 **Index terms**— AIDS brain lesions, CT scan, tuberculous meningitis, HIV encephalitis, cerebral toxoplasmosis  
22 and cryptococcal meningitis.

## 23 **1 Computed Tomography Examination Reveals**

24 Brain Lesions in Guangzhou AIDS Patients Abstract-Cranial computed tomography (CT) plays an important  
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26 treatment results has not yet been completed. In this study, we conducted an investigation on the usefulness of  
27 cranial CT examination in diagnosing HIV patients. Among them, 34 AIDS patients tested positive for brain  
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32 lesions. Additionally, we demonstrated that a count of less than 50 CD4 + T lymphocytes primarily occurred in  
33 the TBM and HIVE groups, thus resulting in higher mortality.

34 **Keywords:** AIDS brain lesions, CT scan, tuberculous meningitis, HIV encephalitis, cerebral toxoplasmosis  
35 and cryptococcal meningitis. tuberculous meningitis often relies on image features supplied by CT and MR  
36 (magnetic resonance) scans; however, it is desirable if a histological examination is available. An operation is  
37 required if there is hydrocephalus associated with TBM 7,8 . HIV encephalitis (HIVE) refers to a complex  
38 of neuropathological alterations induced by the infiltration of HIV-infected macrophages in the early stages of  
39 HIV infection9, 10. It should be noted that antiretroviral therapy (HAART) has quickly altered HIV related  
40 neuropathology and neurological manifestations, which could lead to confusion in the treatment of AIDS 9  
41 . Cryptococcal meningitis (CM) presents in brain lesions of AIDS patients because cryptococcus neoformans  
42 tend to be present in cerebrospinal fluid. The manifestations of cryptococcal meningitis are characterized by  
43 nonspecific symptoms, such as headache, fever, nausea, or altered mental state/behaviour. To confirm the CM

### 3 IV. DISCUSSION

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44 diagnosis, a lumbar puncture appears to be vital 11 . Cerebral toxoplasmosis (CT) is one of the most frequent  
45 pathogens that causes brain lesion complication in AIDS patients, especially in developing countries. CT is  
46 fatal if not treated properly, although there is possibility for complete recovery as long as the patient is treated  
47 legitimately 12,13 .

48 To diagnose the neurological complications of AIDS, the imaging data supplied by computed tomography (CT)  
49 and magnetic resonance (MR) are indispensable. The CT scan is more useful in the diagnosis and evaluation of  
50 focal brain lesions, particularly when a MRI facility is not available in underequipped hospitals. For example, a CT  
51 scan is able to specifically diagnose cerebral toxoplasmosis in approximately 80% of cases 14 . The accumulating  
52 evidence indicates that by mastering the characteristics of the neurological complications of AIDS in CT scans,  
53 we can further diagnose these complications and evaluate treatment results. In this study, we performed an  
54 investigation of 35 CT scan images of AIDS patients with neurological complications at the 8th Guangzhou  
55 People's Hospital.

## 56 2 II. Materials and Methods

57 a) Patients General: From 2004 to 2009, 65 AIDS patients were diagnosed using clinical and laboratory  
58 examinations at the 8 th Guangzhou People's Hospital. Among the 65 I. Introduction cquired immune deficiency  
59 syndrome (AIDS) is caused by an infection of the human immunodeficiency virus (HIV); hence, it is also known  
60 as HIV disease/infection 1,2 . Since being discovered, AIDS has caused the deaths of millions of people's deaths  
61 all over the world. Unfortunately, AIDS is far from stable in the world 3,4 . In fact, AIDS itself does not cause  
62 death; it interferes dramatically with the human immune system because of the progression of the infection, and  
63 it causes HIV-infected people to be considerably more susceptible to common infections, thus enhancing mortality  
64 in such conditions 5 .

65 The human immunodeficiency virus and acquired immunodeficiency syndrome can result in several types of  
66 complications in the central or peripheral nervous system, which comprise nearly 15 to 40 percent of all AIDS  
67 or HIV complications 6 . Tuberculous meningitis (TBM) is one of two brain tuberculosis manifestations. The  
68 diagnoses of A Ming-ya Zhang 1 # , Meng Liu 2 # , Hui Zhao The 65 patients suffering from AIDS, proven  
69 by their clinical and laboratory examination results, were examined using computed tomography (CT) scan at  
70 the 8th Guangzhou People's Hospital from 2004 to 2009. Among the 65 AIDS patients, 45 patients are male  
71 (69.2%) and 20 patients are female (31.8%). The patients range in age from 11 to 65 years old, and the average  
72 age is 39.3 years old (Table ??). and the incidence of these complications were 35.4% (n=23/65) in TBM,  
73 29.2% (n=19/65) in HIVE, 16.9% (n=11/65) in CT and 18.5% (n=12/65) in CM (Figure 1A). Among the same  
74 65 patients who had been diagnosed with AIDS, numerous brain lesions could be seen in the CT scans of 34  
75 patients. They will be denoted as brain lesion positive in the remainder of this report. These brain lesions  
76 included low density foci, local mess effect, ventricle extension, hydrocephaly and encephalopathy, as illustrated  
77 in Figure 2A-D. We determined that the CT scan revealed that 53.3% (n=34/65) of the AIDS patients had brain  
78 lesions whereas 47.7% (n=31/65) of the patients did not (Figure 1B). In the CT-indicated positive brain lesion  
79 cases, there were 50.0% (n=17/34) HIV+TBM, 23.5% (n=8/34) HIVE, 14.7% (n=5/34) HIV+CT and 11.8%  
80 (n=4/34) HIV+CM (Figure 1C). Additionally, low density foci was the most predominant syndrome observed in  
81 CT scans for patients with AIDS combined with tuberculous meningitis (TBM) (Figure 1A1). Encephalopathy  
82 was the most apparent syndrome observed in CT scans for patients with AIDS combined with encephalitis (HIVE)  
83 (Figure 1B1). Furthermore, encephalopathy was observed relatively more often in CT scans compared to other  
84 syndromes in AIDS combined with cryptococcal meningitis (CM) (Figure 1C1). Low density foci and local mess  
85 effect were more common syndromes compared to others in AIDS combined with cerebral toxoplasmosis (CT)  
86 (Figure 1D1).

87 Furthermore, we conducted a questionnaire survey on the personal lifestyle of the 34 AIDS patients with  
88 CT-indicated brain lesions. Among these patients, 12 visited prostitutes (35.5%), 10 abused drugs (29.4%), 3  
89 possessed multiple sexual partners (8.8%), 4 patients' spouses suffered from AIDS (11.8%), 2 visited prostitutes  
90 and abused drugs (5.9%), 2 visited prostitutes and had blood transfusions (5.9%), and 1 abused drugs and had  
91 blood transfusions (2.9%) (Table 2).

92 The CD4 + T lymphocyte numbers were counted in the four AIDS complications (TBM, HIVE, CM and  
93 CT) (Table 3), in which a CD4 + T lymphocyte count of less suggesting that CD4 + T lymphocyte numbers  
94 dramatically reduced after the AIDS infection was combined with these complications. e complications might  
95 increase the death rate of the AIDS patients. Here, we demonstrate that the highest mortality of AIDS patients  
96 with those complications occurred in the TBM group (Table 4).

## 97 3 IV. Discussion

98 Neurological complications account for approximately 40-80% of patients with the human immunodeficiency virus  
99 (HIV) infection, especially at a higher frequency in the late stages of severe acquired immune deficiency syndrome  
100 (AIDS) 16,17 . To diagnose AIDS-related brain complications, physicians typically use brain imaging information,  
101 including internal bleeding, white matter irregularities, and other brain abnormalities based on the patients'  
102 medical history and laboratory examination. Furthermore, the diagnosis can be made by combining the general  
103 neurological exam to assess various nervous system functions with the brain imaging data, which are primarily

104 supplied by CT and MRI scans. Furthermore, the majority of brain image information is obtained through CT  
105 examination due to the expensive costs of MRI examinations in most counties. Thus, precise and thorough CT  
106 scans for AIDS-related brain complications are absolutely indispensable. In this study, we conducted cranial  
107 CT scans for 65 AIDS patients who visited doctors from 2004 to 2009 at the 8th Guangzhou People's Hospital.  
108 A cardinal CT scan revealed that 34 AIDS patients had various brain complications among the 65 patients.  
109 Although there were a few differences in the patients' gender and age, we did not determine any significant  
110 impact of gender and age difference on the CT scan. The combination of AIDS with these images of AIDS-related  
111 brain complications (Table-1). However, the positive CT scan AIDS complications in epidemiological statistics  
112 indicated that 35% of patients had a history of visiting prostitutes, and 29% of patients had a history of drug  
113 abuse among the positive CT scan cases, suggesting that visiting prostitutes or abusing drugs certainly enhanced  
114 the risk of having AIDS brain complications (Table -2). Clearly, we could also see other factors, such as multiple  
115 sexual partners and spouses with AIDS, contribute to AIDS related brain complications.

116 Out of 65 AIDS patients, the percentages of tuberculous meningitis (TBM), cryptococcal meningitis, cerebral  
117 toxoplasmosis (CT) and HIV encephalitis were 35.4%, 18.5%, 16.9% and 29.5%, respectively. Furthermore, the  
118 percentages of the percentages of tuberculous meningitis (TBM), cryptococcal meningitis, cerebral toxoplasmosis  
119 (CT) and HIV encephalitis became 50.0%, 11.8%, 14.7% and 23.5%, respectively in the 53% of CT scan-indicated  
120 AIDS-related brain complications, thus demonstrating that AIDS with tuberculous meningitis (HIV+TBM)  
121 accounted for half of the brain complications (Fig. 1). This observation is similar to reports by other authors<sup>18</sup>.  
122 It should be noted that AIDS with brain lesions could present as various clinical manifestations or multiple  
123 nervous system manifestations simultaneously, or one clinical manifestation could be derived from different  
124 pathogenesis. The primary cause for AIDS patients in later stages to see doctors in this study was because  
125 of neurological symptoms induced by AIDS-related brain lesions. There are different image characteristics for  
126 various AIDS-related brain lesions in CT scans. Additionally, these image features in the CT scan could be useful  
127 for diagnosing different AIDS-related brain lesions. For example, low density foci in a tuberculous meningitis  
128 (TBM) CT scan indicates an enlarged brain ventricle, hydrocephaly and encephalopathy. The CT scan images of  
129 HIV encephalitis (HIVE) indicate the presence of broadening subarachnoid space and bilateral ventriculomegaly.  
130 The CT scan images of cryptococcal meningitis (CM) present a significant enhancement of bilateral cerebral  
131 hemisphere meninx intensity. Furthermore, more low density foci with adjacent oedema and local mess effect  
132 appear in CT scan images of cerebral toxoplasmosis (CT).

133 Additionally, we determined that the CD4+ T lymphocyte count, one indicator for evaluating HIV infection  
134 and treatment effect, dramatically dropped (<50) in the TBM and HIVE groups (Table-3). Similarly, a higher  
135 mortality of patients who had AIDS with brain lesions could be found in the TBM and HIVE groups, suggesting  
136 that it is noteworthy that our physicians should pay more attention to the progress of AIDS with various brain  
137 lesions because they could result in a risk to human life. Clearly, a more precise combination of clinical syndromes  
138 and CT scan imaging is required in the future to explore the correlation of the types of AIDS brain diseases and  
139 their progress.

## 140 4 Conflicts of interest

141 The authors declare that there are no conflicts of interest.

142 Figure Legends



Figure 1:

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Patients	Percentage(%)
<b>Sex</b>	
male	45(69.2%)
female	20(31.8%)
<b>Age group</b>	
<b>(mean 39.3 yrs, range 11-65 yrs)</b>	

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<b>History taking</b>	<b>Number</b>	<b>Percentage</b>
<b>visiting prostitutes</b>	<b>12</b>	<b>35.3%</b>
<b>drug abuse</b>	<b>10</b>	<b>29.4%</b>
<b>multiple sexual partner</b>	<b>3</b>	<b>8.8%</b>
<b>spouse with AIDS</b>	<b>4</b>	<b>11.8%</b>
<b>visiting prostitutes &amp; drug abuse</b>	<b>2</b>	<b>5.9%</b>
<b>visiting prostitutes &amp; blood transfusion</b>	<b>2</b>	<b>5.9%</b>
<b>drug abuse &amp; blood transfusion</b>	<b>1</b>	<b>2.9%</b>
<b>total</b>	<b>34</b>	<b>100%</b>

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Figure 3:

<b>CD4<sup>+</sup> count</b>	<b>TBM</b>	<b>HIVE</b>	<b>CM</b>	<b>CT</b>	<b>Total(%)</b>
<b>&lt;50</b>	<b>7</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>21(61.8%)</b>
<b>100-199</b>	<b>5</b>	<b>1</b>	<b>0</b>	<b>1</b>	<b>7(20.6%)</b>
<b>50-99</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>4 (11.8%)</b>
<b>≥200</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2 (5.9%)</b>

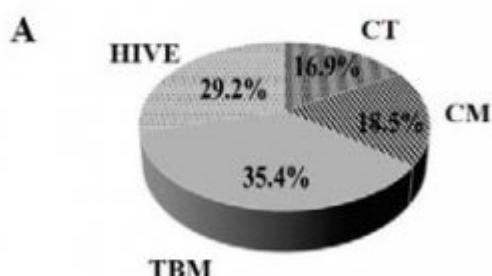
Figure 4:

	TBM	HIVE	CM	CT
<b>number of deaths</b>	4	3	2	1
<b>total</b>	17	8	4	5
<b>mortality</b>	<b>11.8%</b>	<b>8.8%</b>	<b>5.9%</b>	<b>2.9%</b>

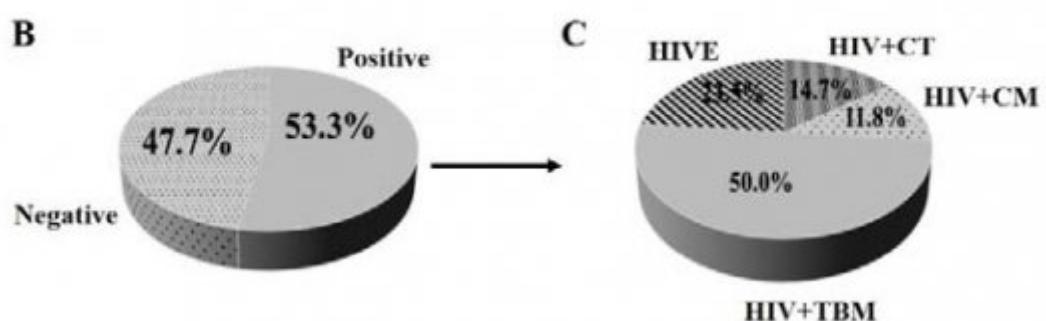
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Figure 5: Fig. 1 :

**The incidence of ADIS complications within total 65 patients**



**The incidence of ADIS complications within CT-indicated brain lesion positive**



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Figure 6: Fig. 2 :

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### b) Diagnosis

AIDS diagnosis: AIDS could be diagnosed if the patients had epidemiological history (Table 2), HIV positive results in laboratory examination, and any one of the following: fever for more than one month without specific reason, chronic diarrhoea ( $>3$  times/day) for more than one month, over 10% weight loss within half a year, repeated

simplex/herpes zoster virus infection, pneumocystis pneumonia, repeated bacterial pneumonia, active tuberculosis/mycobacterium tuberculosis, deep fungal infection, occupancy lesions in the central nervous system, middle-age dementia, active cytomegalovirus infection, infection, repeated sepsis and Kaposi's sarcoma in the skin or viscera.

AIDS complication diagnosis: The diagnosis of tuberculous meningitis (TBM), HIV encephalitis (HIVE), cryptococcal toxoplasmosis (CT) was followed by the respective standards of the Chinese Medical Association Branch of Infection Diseases in 200415.

oral candidiasis, repeated her-

toxoplasma cerebropathy, per-

meningitis(CM)nd

cer

Figure 7:

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*[Note: than 50 occurred in 61.8% (n=21/34) of AIDS with complications, and they occurred more often in the TBM and HIVE groups; almost none of the complications had CD4 + T lymphocyte numbers higher than 200, thus]*

Figure 8: Table 2 :

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Figure 9: Table 3 :

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Figure 10: Table 4 :

#### **4 CONFLICTS OF INTEREST**

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