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NON-CONTRAST HEAD CT FEATURES IN HIV PATIENTS WITH AND WITHOUT ANTIRETROVIRAL THERAPY

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ABSTRACT

Background: Human Immunodeficiency Virus (HIV) weakens the immune system and leads to Acquired Immune Deficiency Syndrome (AIDS). Patients may also develop cerebral toxoplasmosis. The purpose of this study is to investigate non-contrast head CT images in HIV/AIDS patients who have received and have not received antiretroviral (ARV) therapy.
Methods. This descriptive, cross-sectional study was conducted from August 2021 to July 2022 at Adam Malik Hospital, Medan. Data is presented in variables such as age, gender, and non-contrast head CT scan images. Chi-square tests were used for bivariate analysis, with p-values <0.05 considered significant
Results. The mean age of patients receiving and not receiving ARVs was 35.0 ± 12.83 years and 37.3 ± 12.5 years, respectively. The majority were male. Most patients on ARV showed no lesions on CT scans. The Kruskal-Wallis test indicated a significant difference in the proportion of patients based on the number of lesions (p=0.001) between the groups.
Conclusion: Hypodensity lesions are most common in HIV patients, with a non-contrasting CT scan of the head

Keyword: HIV; CT-Scan; Antiretrovirals; Toxoplasmosis; Infections

ABSTRAK

Latar belakang *Human Immunodeficiency Virus (HIV) mampu melemahkan sistem kekebalan tubuh dan menyebabkan Acquired Immune Deficiency Syndrome (AIDS). Pasien juga dapat menderita toksoplasmosis serebral. Tujuan dari penelitian ini adalah untuk menyelidiki citra CT kepala non-kontras pada pasien HIV/AIDS yang telah menerima dan belum menerima terapi antiretroviral (ARV).*
Metode*. Studi deskriptif dan cross-sectional ini dilakukan dari Agustus 2021 hingga Juli 2022 di Rumah Sakit Adam Malik, Medan. Data disajikan dalam variabel seperti usia, jenis kelamin, dan gambar CT scan kepala non-kontras. Uji chi-square digunakan untuk analisis bivariat, dengan nilai-p <0,05 dianggap signifikan.*
Hasil*. Usia rata-rata pasien yang menerima dan tidak menerima ARV masing-masing adalah 35,0 ± 12,83 tahun dan 37,3 ± 12,5 tahun dan mayoritas pasien adalah laki-laki. Sebagian besar pasien dengan ARV tidak menunjukkan lesi pada CT scan. Tes Kruskal-Wallis menunjukkan perbedaan yang signifikan dalam proporsi pasien berdasarkan jumlah lesi (p = 0,001) antar kelompok.*
Kesimpulan. *Temuan lesi hipodensitas adalah paling umum pada pasien HIV, dengan pemeriksaan CT scan kepala non-kontras*

Keyword: *HIV; CT-Pindai; Antiretroviral; toksoplasmosis; Infeksi*

1. Introduction

Human Immunodeficiency Virus (HIV) targets the immune system, leading to Acquired Immune Deficiency Syndrome (AIDS) and resulting in a weakened immune response. HIV patients often face opportunistic infections due to their compromised immune systems [1]. According to the United Nations Program on HIV/AIDS (UNAIDS), 38.4 million people were living with HIV globally in 2021 [2]. In Indonesia, the Ministry of Health reported a cumulative total of 530,000 HIV cases by 2022 [3]. Individuals with HIV generally have a lower health-related quality of life compared to the general population, influenced by various factors including the presence of opportunistic infections [4]. Non-contrast head CT scans can be used to diagnose certain opportunistic infections and monitor therapeutic responses, particularly in cases of cerebral toxoplasmosis. This infection, caused by the parasite Toxoplasma gondii, frequently occurs in stage 4 HIV patients with CD4 counts below 200 cells/µl. Poor prognosis and high mortality rates during hospitalization underscore the importance of early identification of high-risk cases to improve outcomes [5]. For a definitive diagnosis of cerebral toxoplasmosis, clinical manifestations combined with at least one brain lesion on neuroimaging are necessary. Hypodense brain lesions with ring enhancement, often associated with edema, can be detected using magnetic resonance imaging (MRI). CT scans are the primary imaging modality for identifying central nervous system lesions [6]-[8]. This study specifically examined HIV/AIDS patients, which is a group with a high risk of neurological complications. This makes an important contribution to understanding their health condition. Insights into non-contrast head CT scan images in HIV/AIDS patients can help in the diagnosis and management of the disease, especially concerning antiretroviral therapy. The purpose of this study is to investigate non-contrast head CT images in HIV/AIDS patients who have received and have not received antiretroviral (ARV) therapy.

2. Methods

This descriptive, cross-sectional study was conducted from August 2021 to July 2022 in the Radiology Room at H. Adam Malik General Hospital, Medan, with approval from the Health Research Ethics Commission, Faculty of Medicine, University of Sumatera Utara, and H. Adam Malik General Hospital. The study included 46 patients who met the inclusion and exclusion criteria. Inclusion criteria were being over 18 years of age, having an HIV diagnosis confirmed through a 3-method Rapid Test, and either having taken ART for at least 3 months or never having taken ART. Patients with a history of brain malignancy, incomplete data, or who had undergone a contrast head CT scan were excluded. Data collected from medical records included age, gender, neurological symptoms, and lesion characteristics such as number, location, and type. Assessed neurological symptoms included headache, decreased consciousness, hemiparesis, seizures, and fever. Data analysis was performed using SPSS software, with descriptive statistics presented as numbers (n) and percentages (%) for various variables. Bivariate analysis was conducted using the Chi-square test, with a p-value <0.05 considered significant.

3. Results

Based on Table 1, the mean age of patients who received ARVs was 35 □12.83 years, while those who did not receive ARVs were aged 37.3 □12.5 years (p=0.454). Fischer's Exact test showed no significant difference in neurological symptoms between ARVs (+) with ARVs (-) (p>0.05).

Table 1: Subject Characteristics Based on Neurological Symptoms in HIV/AIDS Patients Who Have and Have Not Received Antiretrovirals

Neurological Symptoms	ARVs (+) n =23,(%)	Neurological Symptoms	ARVs (-) n = 23, (%)	p
Headache,		Headache,		
Yes	10 (43.5)	Yes	11 (47.8)	0,767
No	13 (56.5)	No	12 (52.2)	
Decreased Consciousness		Decreased Consciousness		
Yes	9 (39.1)	Yes	9 (39.1)	1.000
No	14 (60.9)	No	14 (60.9)	
Hemiparesis,		Seizures,		
Yes	3 (13)	Yes	7 (30.4)	0,135
No	20 (87)	No	16 (69.6)	
Seizures,		Hemiparesis,		
Yes	2 (8.7)	Yes	6 (26.1)	0,459[b]
No	21 (91.3)	No	17 (73.9)	
Fever,		Fever,		
Yes	0	Yes	1 (4.3)	1,000[b]
No	23 (100)	No	22 (95.7)	

Based on Table 2, there were significant differences between the proportion of patients with parietal lobe lesions (p=0.036) and basal ganglia lesions (p=0.044).

Table 2. Subject Characteristics Based on Lesion Location in HIV/AIDS Patients with Neurological Symptoms Who Have and Have Not Received Antiretrovirals

Table 2 Distribution and Hardy Weinberg Equilibrium

Lesion Location	ARVs (+) n=23,(%)	Lesion Location	ARVs (-) n=23,(%)	P
Parietal Lobe		Parietal Lobe		
Yes	6 (26.1)	Yes	13 (56.5)	0.036[a]
No	17 (73.9)	No	10 (43.5)	
Temporal Lobe		Frontal Lobe		
Yes	5 (21.7)	Yes	11 (47.8)	0.730[a]
No	18 (78.3)	No	12 (52.2)	
Frontal Lobe		Basal Ganglia		
Yes	5 (21.7)	Yes	9 (39.1)	0.063[a]
No	18 (78.3)	No	14 (60.9)	
Basal Ganglia		Temporal Lobe		
Yes	3 (13)	Yes	6 (26.1)	0.044[b]
No	20 (87)	No	17 (73.9)	
Pons,		Occipital Lobe		
Yes	3 (13)	Yes	5 (21.7)	0.233[a]
No	20 (87)	No	18 (78.3)	
Occipital Lobe		Thalamus		
Yes	2 (8.7)	Yes	5 (21.7)	0.414[b]
No	21 (91.3)	No	18 (78.3)	
Cerebellum		Cerebellum		
Yes	2 (8.7)	Yes	1 (4.3)	1.000[b]
No	21 (91.3)	No	22 (95.7)	
Thalamus,		Pons		
There is	1 (4.3)	There is	0	0.187[b]
There isn't any	22 (95.7)	There isn't any	23 (100)	

Based on Table 3, the Kruskal-Wallis test indicated a significant difference in the proportion of patients based on the number of lesions (p=0.001) between the groups.

Table 3. Characteristics of Subjects Based on the Number of Lesions in HIV/AIDS Patients with Neurological Symptoms

Number of Lesions	ARVs (+) n=23,(%)	ARVs (-) n=23,(%)	p
No lesions	14 (60.9)	2 (8.7)	0.001*
Single Lesion	1 (4.3)	4 (17.4)	
Multiple Lesions	8 (34.8)	17 (73.9)	

*Kruskal Wallis

Based on Table 4, the Chi-Square test indicated a significant difference in the proportion of patients with perifocal edema lesions (p<0.001) between the groups.

Table 4. Characteristics of Subjects Based on Lesion Type in HIV/AIDS Patients with Neurological Symptoms in ARV and non-ARV groups.

Lesion Type	ARVs (+) n=23,(%)	ARVs (-) n=23,(%)	p-value
Hypodense,			
Yes	9 (39.1)	14 (60.9)	0.238[a]
No	14 (60.9)	9 (39.1)	
Perifocal Edema,			
Yes	3 (13)	15 (65.2)	<0,001[a]
No	20 (87)	8 (34.8)	
Isodensity,			
Yes	0	4 (17.4)	0.109[b]
No	23 (100)	19 (82.6)	
Hyperdense,			
Yes	0	1 (4.3)	1.000[b]
No	23 (100)	22 (95.7)	
Cerebral Atrophy,			
Yes	0	2 (8.7)	0.489[b]
No	23 (100)	21 (91.3)	

[a] Chi-Square, [b] Fischer's Exact

4. Discussions

This study included 46 HIV/AIDS patients, divided evenly between two groups, 23 patients who had received antiretroviral therapy and 23 who had not. The mean age of the ARV group was 35.0 ± 12.83 years, while the non-ARV group had a mean age of 37.3 ± 12.5 years. These results are similar to research by Giguere et al., which found that the average age of HIV patients in Canada was 35 years [9]. Similarly, Sari et al. found that the age groups of 26-35 and 36-45 years were prevalent among HIV patients receiving ARVs [10]. The delay in diagnosing HIV, often due to a long asymptomatic period, suggests that many HIV/AIDS patients were initially infected between the ages of 26 and 45. This aligns with the theory that HIV may take weeks to months before causing noticeable symptoms [11].

Headache was the most common neurological symptom among patients receiving ARVs (43.5%) and those not receiving ARVs (47.8%). This finding is consistent with Katabwa et al., who also noted headaches as a frequent symptom in HIV patients with T. Gondii infection [12]. However, Kadri et al. found that while headaches were common, decreased consciousness was less frequently reported [13].

Potential bias may exist in this study due to irregular ARV adherence among patients, as seen in the similar numbers of seizures and headaches between the two groups. Only one patient among the 46 had a fever, suggesting a need for further investigation into ARV adherence and its impact on symptoms.

In terms of lesion location, 6 patients (26.1%) in the ARV group had parietal lobe lesions, and 3 (13%) had basal ganglia lesions, compared to 13 patients (56.5%) and 9 patients (39.1%), respectively, in the non-ARV group. Similar results were found by Somasundram et al., who reported that the parietal lobe and basal ganglia were common lesion sites in HIV patients in South Africa. However, Hadiwiyono et al. in Bali, Indonesia, found the thalamus to be the most frequently affected area [14].

Lesions in the brain, especially ischemic infarctions and infections, often occur in the MCA distribution. These can result in brain infarctions or abscesses and are sometimes associated with mycotic aneurysms and intracranial hemorrhage. This study found 14 patients (60.9%) in the ARV group without lesions, compared to only 2 (8.7%) in the non-ARV group. Multiple lesions were more common in the non-ARV group, aligning with findings by Wiboon et al. in Thailand [15]. In the first group, 14 individuals (60.9%) did not have any lesions, 1 individual (4.3%) had a single lesion, and 8 individuals (34.8%) had multiple lesions. In contrast, in the second group, only 2 individuals (8.7%) were lesion-free, 4 individuals (17.4%) had a single lesion, and 17 individuals (73.9%) had multiple lesions. These findings align with Wiboon et al.'s study at Ramathibodi Hospital in Thailand, which found that out of 264 HIV patients, 200 had no brain lesions, while 64 did have lesions on their head CT scans [16]. Among patients who had received antiretroviral therapy (ARVs), the most common type of lesion was hypodense, found in 9 individuals (39.1%). In patients who had not received ARVs, perifocal edema was the most common lesion type, observed in 15 individuals (65.2%). These results

are similar to those reported by Kheerati et al., who found that HIV-related head lesions are often due to encephalopathy and toxoplasmosis infection, predominantly presenting as hypodense lesions [17].
Hypodense lesions in infections are caused by infected thromboembolisms blocking cerebral blood vessels, leading to ischemic attacks from vascular occlusion and infectious attacks from the infection nidus. This can result in brain infarction or a brain abscess. Mycotic aneurysms, which can develop from septic embolism sites, account for less than 10% of neurological complications in infective endocarditis, with potential complications including intracranial hemorrhage, ischemic stroke, ventriculitis, and brain abscesses [16]. AIDS patients frequently suffer from various intracranial opportunistic infections and malignant tumors, with Toxoplasma gondii being a significant pathogen. Globally, about 35.7 million people are infected with this pathogen. Early diagnosis and treatment of toxoplasmosis can improve survival and reduce mortality in these patients [18].
Plain CT scans have lower sensitivity and specificity compared to enhanced CT scans due to lower tissue resolution, but they are still recommended for initial screening. The characteristic feature of toxoplasmosis on a CT scan is multiple supratentorial lesions, particularly in the basal ganglia, thalamus, and corticomedullary junction. Non-contrast CT scans typically show multiple round hypodense lesions, with hyperdense nodules in cases of bleeding. Lesion sizes vary from under 1 cm to over 3 cm, and post-contrast enhancement usually reveals smooth, thin-walled ring enhancements. Some lesions may also exhibit perifocal edema and an occupying effect [18]-[19]. The infectious diseases of the CNS are most commonly caused by various types of bacteria or viruses. Other less common organisms include fungi or protozoans, etc. These pathogens enter the CNS through two main routes of transmission: hematogenous spread from distant infections such as endocarditis or urinary tract infection, or direct extension from infections of the adjacent structures such as sinusitis or mastoiditis. Hematogenous transmission tends to produce diffuse or multifocal lesions in different vascular distributions, such as diffuse meningitis or septic emboli. Direct extension of the infections usually gives rise to focal lesions, such as subdural or epidural empyema [20].
This study has a focused population that specifically targets HIV patients undergoing and not undergoing antiretroviral therapy (ARV), which provides insights into a crucial health issue in a defined population. There are a few limitations that should be considered. First, the small sample size may reduce the statistical power and limit the generalizability of the findings. Second, as the research was conducted at a single hospital, it lacks the diversity and broader applicability that a multicenter study could provide. Finally, the absence of follow-up CT scans prevents the evaluation of long-term potential changes of the lesion over time, which could further inform the study's conclusions.

5. Conclusions

Headache is the most frequent symptom among these patients. ARV recipients typically showed no lesions on CT scans, whereas non-ARV recipients had lesions, with hypodense lesions being the most common among ARV patients and perifocal edema among non-ARV patients.

Competing interests

The author declares no conflict of interest

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