Original Research Report

CHARACTERISTICS OF APHASIA IN ISCHEMIC STROKE PATIENTS AT A NATIONAL BRAIN CENTER IN INDONESIA

Rasya Hapsari Danardhono[1*], Arman Yurisaldi Saleh[2], Ria Maria Theresa[3], Riezky Valentina Astari[2]

[1]Faculty of Medicine, Universitas Pembangunan Nasional "Veteran" Jakarta, Jakarta, Indonesia
[2]Department of Neurology, Faculty of Medicine, Universitas Pembangunan Nasional "Veteran" Jakarta, Jakarta, Indonesia
[3]Department of Psychiatry, Faculty of Medicine, Universitas Pembangunan Nasional "Veteran" Jakarta, Jakarta, Indonesia

ABSTRACT

Different types of aphasia may occur due to lesions in various brain regions following ischemic strokes. Global aphasia was the most prevalent type of aphasia before the COVID-19 pandemic. However, stroke incidence and mortality rose during the pandemic. This study aimed to identify the types, clinical and radiological features, and management of aphasia in ischemic stroke cases during the pandemic. This study was a descriptive study with a cross-sectional design. The total sampling technique was used for the sampling process. The research samples were ischemic stroke subjects with aphasia who were diagnosed between January 1 and December 31, 2021, at the National Brain Center Prof. Dr. dr. Mahar Mardjono Hospital, Jakarta, Indonesia. The statistical analysis was performed using IBM SPSS Statistics for Mac, Version 25.0 (IBM Corp., Armonk, N.Y., USA). The results of this study showed that 162 aphasic subjects had suffered from ischemic strokes. The age range of the subjects was 34–87 years old. The majority of the subjects were male (59.9%) and aged 55–65 years (37.0%). The three most common risk factors were hypertension (90.1%), diabetes mellitus (50.0%), and dyslipidemia (75.9%). Motor aphasia (33.3%) and global aphasia (43.8%) were the most prevalent types of aphasia among the subjects. The parietal lobe was the main location of the causative lesions, as demonstrated by 38 global aphasic subjects and 47 motor aphasic subjects. The therapies administered to the subjects consisted of speech therapy (85.2%), antiplatelet therapy (98.1%), anticoagulants (19.1%), recombinant tissue plasminogen activator (rTPA) (1.2%), and neuroprotectors (3.0%). This study concluded that global aphasia was the most common type of aphasia among ischemic stroke patients during the pandemic, with the parietal lobe as the primary location of the causative lesions.

Keywords: Aphasia, ischemic stroke, health risk, cardiovascular disease, obesity

***Correspondence:** Rasya Hapsari Danardhono, Faculty of Medicine, Universitas Pembangunan Nasional "Veteran" Jakarta, Jakarta, Indonesia. Email: rasyahapsarid@upnvj.ac.id

Article history
●Submitted 19/1/2023 ● Revised 12/10/2023 ● Accepted 25/11/2023 ● Published 10/12/2023

How to cite: Danardhono RH, Saleh AY, Theresa RM, et al (2023). Characteristics of Aphasia in Ischemic Stroke Patients at a National Brain Center in Indonesia. Folia Medica Indonesiana 59 (4), 342-351, https://doi.org/10.20473/fmi.v59i4.42746

pISSN:2355-8393, eISSN: 2599-056x

Highlights:
1. This study was the first study identifying the characteristics of aphasia among ischemic stroke patients during COVID-19 pandemic at a national brain center in Indonesia.
2. This study provides additional data for future studies to conduct a comparison between the pre- and post-pandemic incidence of aphasia.

INTRODUCTION

Stroke is an acute neurological condition that became the third-most common cause of disability worldwide in 2013. In terms of causes of mortality, stroke ranked second globally in the same year. Stroke patients may experience focal and global neurological deficits due to vascular impairments (Feigin et al. 2017). The worsening of neurological symptoms may occur within the first 24 hours or later since the onset of the symptoms.

The prevalence of stroke has been known to increase with age. According to the 2018 Basic Health Research, 10.9% of Indonesians have experienced stroke. Stroke diagnosis rates were lowest in the 15–

24 age group (0.2%) and highest in those over 75 years old (43.1%). However, stroke incidence has been showing an increase among individuals under the age of 45 (Ministry of Health of the Republic of Indonesia 2014, 2019a).

There was an increase in the number of stroke cases during the COVID-19 pandemic. The mortality rate for patients with ischemic stroke increased due to the impact of COVID-19 infections, particularly in severe cases (Mubasher et al. 2021, Utomo 2022). The COVID-19 infection triggers ischemic strokes through several mechanisms. The three main mechanisms are the hypercoagulable state, vasculitis, and cardiomyopathy (Spence et al. 2020).

Following an incidence of stroke, the patient may experience aphasia. Approximately 12% of stroke survivors are affected by aphasia (Giulio 2020, Mitchell et al. 2021). Aphasia is the disruption of expressive or receptive language that arises due to damage to certain areas of the brain. This condition is classified according to the location of the causative lesion and the resulting clinical manifestations. The classification comprises global aphasia, motor aphasia, sensory aphasia, conduction aphasia, anomic aphasia, and transcortical aphasia (Hasanah 2017).

In East Jakarta, Indonesia, there is a national referral hospital known as the National Brain Center Prof. Dr. dr. Mahar Mardjono Hospital that specializes in treating patients with nervous disorders, specifically stroke. According to the 2018 data from the hospital's annual report, ischemic stroke was the most frequent disease treated in the emergency room. Out of 6,281 patients, 2,730 (43.4%) suffered from stroke, with 2,082 (76.3%) diagnosed with ischemic stroke. Secondary preventive measures play a crucial role in reducing the incidence of neurological deficits. Such measures can be implemented by comprehending the characteristics of aphasia in ischemic stroke patients (Kleindorfer et al. 2021). Therefore, the purpose of this study was to identify the characteristics of aphasia in ischemic stroke subjects at the National Brain Center Prof. Dr. dr. Mahar Mardjono Hospital, Jakarta, Indonesia, during the COVID-19 pandemic.

MATERIALS AND METHODS

This study was conducted at the National Brain Center Prof. Dr. dr. Mahar Mardjono Hospital, Jakarta, Indonesia, in October 2022. This descriptive study used a cross-sectional design with a total sampling technique for obtaining research samples (Setia 2016). Ischemic stroke patients with aphasia served as the research subjects for this study. All subjects gave consent to be involved in this research.

The inclusion criteria for the research subjects were ischemic stroke patients who experienced aphasia, were over the age of 18, and had a diagnosis through a computed tomography scan (CT scan) and/or magnetic resonance imaging (MRI) between January 1 and December 31, 2021. Patients who had a history of brain trauma and/or neurological conditions other than ischemic stroke were excluded from this study (Vilela & Rowley 2017).

A neurologist obtained the data through examinations during ward rounds and history-taking. A univariate analysis was performed using IBM SPSS Statistics for Mac, Version 25.0 (IBM Corp., Armonk, N.Y., USA) to calculate the frequency, proportion, and mean of the data. The types of aphasia were identified according to the Boston classification of aphasia (Fong et al. 2019).

RESULTS

Out of the 240 patients, 162 subjects met the inclusion criteria for data analysis after 42 patients were excluded. Table 1 shows the general characteristics of the research subjects. The subjects' ages ranged from 34 to 87 years, with a median age of 59.82 years. As many as 60 subjects (37%) were in the 55–65 age group and made up the majority of the samples. We found that male patients (97 subjects; 59.9%) experienced aphasia in ischemic stroke at a higher prevalence rate than female patients (65 subjects; 40.1%). The most common risk factors identified in this study were diabetes mellitus (50.0%), hypertension (90.1%), and dyslipidemia (759.9%). A history of stroke (33.3%), coronary heart disease (22.2%), atrial fibrillation (5.6%), and increased blood viscosity (17.3%) were other risk factors identified in this study. However, data on the patients' smoking status were not available for 80.9% of the subjects.

This study documented several aphasia therapeutic modalities, including rehabilitation, brain stimulation, and pharmacological treatment. A total of 138 subjects (85.2%) received rehabilitation, while the other 24 subjects (14.8%) did not. This might be due to the subjects' poor condition, which prevented them from performing the required exercises. No subject received transcranial magnetic stimulation (TMS). Nearly all of the subjects, with as many as 159 individuals (98.1%), received antiplatelets. Only 31 subjects (19.1%) received anticoagulants. Neuroprotectors (e.g., citicoline and piracetam) were only administered to five subjects (3.0%).

Table 1. General characteristics of the ischemic stroke patients with aphasia.

Categories	n (162)	%
Age (years)		
<55	51	31.5
55–65	60	37.0
66–75	36	22.2
>75	15	9.3
Sex		
Male	97	59.9
Female	65	40.1
BMI		
Underweight	2	1.2
Normal	60	37.0
Overweight	27	16.7
Class I obese	42	25.9
Class II obese	20	12.3
Not available	11	6.8
Hypertension		
Yes	146	90.1
No	16	9.9
Diabetes mellitus		
Yes	81	50.0
No	81	50.0
Dyslipidemia		
Yes	123	75.9
No	39	24.1
Stroke history		
Yes	54	33.3
No	108	66.7
Ischemic heart disease		
Yes	36	22.2
No	126	77.8
Atrial fibrillation		
Yes	9	5.6
No	153	94.4
Hypercoagulable state		
Yes	28	17.3
No	134	82.7
Smoking status		
Active smoker	25	15.4
Non-smoker	4	2.5
Ex-smoker	2	1.2
Not available	131	80.9
Rehabilitation		
Yes	138	85.2
No	24	14.8
Brain stimulation		
Yes	0	0.0
No	162	100.0
Pharmacological treatment		
Anticoagulant	31	19.1
Antiplatelet	159	98.1
rTPA	2	1.2
Neuroprotector	5	3.0

Notes: BMI=body mass index;
rTPA=recombinant tissue plasminogen activator.

Table 2 displays the distribution of aphasia types among the research subjects. Global aphasia was the predominant type of aphasia among the subjects, with a prevalence of 71 cases (43.8%). The second and third most common types were motoric aphasia (54 subjects; 33.3%) and sensory aphasia (20 subjects; 12.3%), respectively. Aphasia types with a rare distribution in this study were transcortical motor aphasia (8 subjects; 4.9%), sensory transcortical aphasia (7 subjects; 4.3%), and anomic aphasia (2 subjects; 1.2%).

Table 2. Distribution of aphasia types in ischemic stroke subjects.

Aphasia types	Total	
	n	%
Sensory	20	12.3
Motor	54	33.3
Transcortical sensory	7	4.3
Transcortical motor	8	4.9
Global	71	43.8
Anomic	2	1.2
Total	162	100.0

Table 3 presents the distribution of lesion locations among the aphasic subjects. The lesion locations were organized and classified according to the three main parts of the brain and its lobes, as shown in Table 4. It was found that the temporal lobe was the most common location of the causative lesion in sensory aphasia cases. In the meantime, the frontal lobe, corona radiata, and frontal lobe were the primary locations of causative lesions in motor aphasia, transcortical motor aphasia, and global aphasia cases, respectively. The transcortical sensory aphasia cases revealed that the frontal, parietal, and temporal lobes were the three areas most frequently affected. In the anomic aphasia cases, the frontal and parieto-temporal lobes were the two most often damaged areas.

In subjects with sensory aphasia and an ischemic stroke history, the lesions were identified in the temporal lobe (15 subjects), parietal lobe (15 subjects), frontal lobe (8 subjects), and occipital lobe (2 subjects). In addition, one subject with a cerebellar lesion and one subject with a brain stem lesion both had sensory aphasia. Subjects with motor aphasia exhibited lesions in the parietal lobe (47 subjects), frontal lobe (36 subjects), temporal lobe (25 subjects), occipital lobe (15 subjects), cerebellum (6 subjects), and brain stem (5 subjects). Subjects with transcortical sensory aphasia had lesions in the parietal lobe (6 subjects), temporal lobe (5 subjects), frontal lobe (3 subjects), occipital lobe (2 subjects), cerebellum (1 subject), and brain stem (1 subject). Subjects with transcortical motor aphasia showed lesions in the parietal lobe (7 subjects), frontal lobe (3 subjects), temporal lobe (3 subjects), occipital lobe (3 subjects), and cerebellum (1 subject). Furthermore, subjects with global aphasia demonstrated lesions in the parietal lobe (66 subjects), frontal lobe (58 subjects), temporal lobe (47 subjects), occipital lobe (27 subjects), brain stem (7 subjects), and cerebellum (4 subjects).

Table 3. Distribution of the lesion locations among the subjects.

Lesion locations	Aphasia types (n)					
	Sensory	Motor	Transcortical sensory	Transcortical motor	Global	Anomic
Corona radiata	5	24	1	4	33	0
Frontal lobe	3	26	2	2	38	1
External capsule	3	9	0	2	7	0
Basal ganglia	1	21	1	3	29	0
Temporo-parieto-occipital lobe	0	1	1	0	0	0
Posterior insula	3	1	0	0	3	0
Fronto-parieto-temporal lobe	0	2	0	0	10	0
Cerebral peduncle	0	0	0	0	1	0
Parieto-temporal lobe	4	1	1	1	3	1
Parietal lobe	3	7	2	1	11	0
Temporal lobe	7	4	2	1	10	0
Fronto-parietal lobe	0	3	0	0	4	0
Parieto-occipital lobe	0	2	0	1	3	0
Pons	0	5	1	0	6	0
Insula	3	10	1	0	17	0
Occipital lobe	0	2	0	2	4	0
Cerebellum	1	6	0	1	4	0
Corpus callosum	0	2	0	0	1	0
Internal capsule	1	7	1	0	9	0
Anterior insula	0	1	0	0	0	0
Fronto-temporal lobe	1	1	0	1	5	0
Lateral periventricular	2	7	1	0	16	0
Centrum semiovale	0	3	1	1	4	0
Thalamus	1	11	0	0	8	0
Temporo-occipital lobe	0	3	0	0	2	0
Caudate nucleus	1	3	1	0	2	0
Lenticular nucleus	1	0	0	0	3	0
Fronto-temporo-parieto-occipital lobe	0	0	0	0	1	0
Watershed area	0	0	0	0	1	0

As shown in Table 4, we found lesions in the frontal lobe (1 subject), temporal lobe (1 subject), and parietal lobe (1 subject) of the research subjects who experienced anomic aphasia. These results demonstrated the categorical data synthesized from the more detailed lesion location distribution. Among the subjects with anomic aphasia, one individual had a temporoparietal lobe lesion, while the other individual had a single frontal lobe lesion.

Table 4. Distribution of lesion locations according to the main parts of the brain.

Lesion locations	Aphasia types (n)					
	Sensory	Motor	Transcortical sensory	Transcortical motor	Global	Anomic
Cerebrum						
Frontal lobe	8	36	3	3	58	1
Temporal lobe	15	25	5	3	47	1
Parietal lobe	15	47	6	7	66	1
Occipital lobe	2	15	2	3	27	0
Cerebellum	1	6	1	1	4	0
Brain stem	1	5	1	0	7	0

DISCUSSION

General characteristics of ischemic stroke patients with aphasia

The findings from our study were consistent with those of earlier studies. It was previously found that the average age of aphasic patients was 55.8 years old. The patients were between the ages of 50 and 60 (Fitri & Lastri 2019, Khedr et al. 2021). The risk of stroke has been shown to increase as people age. This is because of the thickening and loss of elasticity of the tunica intima in blood vessels, which causes a decrease in the blood flow of the brain (Sofyan et al. 2013).

A previous study conducted by Hasanah (2017) showed that aphasia with an acute stroke history was more common in men (10 subjects; 58.8%) than in women (7 subjects; 41.2%). The incidence of stroke was also higher in men than women, even at younger ages. Nonetheless, the incidence of stroke in women increases with age due to the neuroprotective effect of estrogen on the brain (Bushnell et al. 2018).

The results of our study were in line with previous investigations regarding the risk factors for aphasia. Hypertension was present in 72.0% of aphasic patients (Couto et al. 2020). A substantial number of aphasic patients also had diabetes mellitus (91.25%), while a smaller number of the patients experienced dyslipidemia (34.9%), atrial fibrillation (37%), and coronary heart disease (26%) (Grönberg et al. 2022). Meanwhile, a study conducted by Rasyid et al. (2019) examined the risk factors for ischemic stroke. They found that blood viscosity was prevalent in 88.6% of ischemic stroke patients.

Smoking has a major impact on stroke incidence. It was found that the risk of stroke increases by 12% for every five cigarette butts consumed per day. Smoking has been associated with atherosclerosis, changes in homocysteine, fibrinogen, and oxidized low-density lipoprotein cholesterol levels. This activity has also demonstrated an association with atrial fibrillation, diabetes mellitus, and hypertension, which are risk factors for stroke (Pan et al. 2019).

In this study, aphasia following an ischemic stroke was more common in overweight individuals. This finding agreed with a previous study conducted by Nabila et al. (2020), who found that ischemic stroke was most prevalent in individuals within the body mass index (BMI) range of 25.0-29.9. Blood lipid imbalance is often associated with excess body weight. It has been demonstrated that obesity can lead to atherosclerosis and increased stroke incidence (Mitchell et al. 2015).

Previous studies indicate that the best time to initiate anticoagulant therapy in ischemic stroke patients has not yet been established, and it requires further research. It is also not recommended to use antiplatelets in combination with anticoagulants as a preventive treatment for secondary stroke (Froio et al. 2017, Kleindorfer et al. 2021). According to the guidelines issued by the Ministry of Health of the Republic of Indonesia (2019b), recombinant tissue plasminogen activator (rTPA) therapy can be administered to ischemic stroke patients with ≤6 hours of symptom onset. Out of 162 subjects in this study, only two patients (1.2%) received rTPA therapy. One research subject was admitted to the hospital with 3 hours of symptom onset, while the other subject came with 30 minutes of symptom onset. The national guidelines recommend the administration of neuroprotectors for stroke patients who have not received reperfusion therapy. However, citicoline and piracetam were not included in the national formulary. This probably led to a decrease in the number of ischemic stroke patients receiving these medications.

Distribution of aphasia types in ischemic stroke patients

We found that the distribution of aphasia types in patients with ischemic stroke was consistent with other studies. Global aphasia was found to be the most common aphasia in the studies conducted by Lee et al. (2018) and Grönberg et al. (2022). In a separate study conducted by Fitri & Lastri (2019), motor aphasia was the most prevalent type of aphasia, with as many as four patients (28.6%). Three patients (21.4%) had global aphasia, making it the second most prevalent type of aphasia in the study.

Lesion locations in patients with sensory aphasia

The parietal lobe is composed of several structures, including the corona radiata, basal ganglia, thalamus, external and internal capsules, and caudate and lentiform nuclei. The corpus callosum and insula lie in three lobes (i.e., frontal, parietal, and temporal lobes), while the lateral periventricle and centrum semiovale are located in every lobe of the brain (i.e., frontal, parietal, temporal, and occipital lobes). In this study, corpus callosum lesions were categorized according to the parts of the corpus callosum affected (from the genus of the corpus callosum to the frontal lobe). A previous study showed that the causative lesions of sensory aphasia were located in the parietotemporal lobe, temporal lobe, basal ganglia, and lentiform nucleus, as well as the external and internal capsules (Khedr et al. 2021, Duron et al. 2022).

Another name for sensory aphasia is Wernicke’s aphasia, which refers to a lesion location known as the Wernicke's area. This area covers the superior temporal gyrus, at the junction of the parietal lobe and the temporal lobe (Døli et al. 2021). While lesions of sensory aphasia are typically found in the Wernicke's area, three aphasic subjects in our study showed evidence of lesions in the frontal lobe as well. In addition, lesions in the basal ganglia, temporal lobe, parietal lobe, and corona radiata of the subjects corroborated the clinical manifestations of sensory aphasia.

In this study, subjects who had lesions in their thalamus also exhibited lesions in their left temporal lobe. As a result, it was possible that there would be overlap between the symptoms of thalamic and sensory aphasia. Thalamic aphasia is characterized by impairments in verbal fluency and comprehension. However, this type of aphasia may also not affect comprehension and repetition abilities in certain cases (Rangus et al. 2022).

The superior cerebellum is involved in the activation of articulations and verbal memory. Nonetheless, lesions in the cerebellum have been associated with motor aphasia Jianu et al. (2022). One subject in our study who experienced sensory aphasia, however, had both cerebellum and temporo-parietal lobe lesions. This might be because temporo-parietal lobe lesions are more closely associated with sensory aphasia. The cerebellum, basal ganglia, and thalamus comprise the cortico-subcortical neural network, which is involved in planning, coordinating, timing, sequencing, and selecting the language production process. The interaction of the fronto-striatal and fronto-temporal pathways involves the basal ganglia in language production. Dysfunction of the circuit can reduce the efficiency of word selection. The integration of the cerebellum, basal ganglia, and thalamus also regulates repetition and speech block. Therefore, disturbances in these areas can lead to stuttering (Silveri 2021).

The insula plays an important role in language processing. Damage to the insula is often associated with motor aphasia, word-deafness in sensory aphasia, and repetition difficulty in conduction aphasia (Ardila 2018). Our study found similar lesions in the insula of subjects who experienced various types of aphasia, including sensory aphasia.

Lateral periventricular area is related to automatic speech production. However, Jianu et al. (2022) revealed that lateral periventricular lesions were frequently associated with motor aphasia. In this study, lesions were found in the lateral periventricular area of two subjects. These subjects also exhibited lesions in the temporal lobe, which corresponded to the clinical manifestation of sensory aphasia.

In this study, one subject each had a lesion in the lenticular nucleus and caudate nucleus. A previous study found that lesions in the caudate and lenticular nuclei were prevalent in patients with sensory aphasia (Bohra et al. 2015). The expansion of the caudate nucleus enhances language switching. The nucleus also works with the thalamus in the process of language selection. In addition, the basal ganglia, which has a role in language processing, is composed of the caudate and lenticularis nuclei (Booth et al. 2007).

According to a prior study conducted by Jianu et al. (2022), posterior insula lesions are more likely to be associated with motor aphasia. However, three subjects who had sensoric aphasia in this study exhibited lesions in the posterior insula. Two of the three subjects also had lesions in the parietotemporal lobe, while the third subject had a lesion in the temporal lobe, which was associated with sensory aphasia. There has been no established association yet between sensory aphasia and lesions in the corona radiata. Therefore, lesions found in the corona radiata of five subjects in this study might have a stronger association with the lesions found in the caudate nucleus, temporal lobe, parietal lobe, and temporo-parietal lobe.

Lesion locations in patients with motor aphasia

Broca's complex and its borders (i.e., dorsolateral prefrontal cortex, supplementary motor area, basal ganglia, and insula) have a role in language processing. Lesions in the anterior insula cause difficulty in verbal fluency (Ardila 2018). Damage to the medial temporal lobe is associated with the auditory comprehension process. Meanwhile, lesions in the frontal lobe and insula may affect repetition ability (Døli et al. 2021). Eleven subjects who had motor aphasia in this study exhibited thalamic lesions accompanied by lesions in the frontal lobe, basal ganglia, and corona radiata in other parts of the lobe, which corresponded to the clinical manifestations of motor aphasia. Lesions in both Broca's area and cerebellum have been associated with severe motor aphasia (Lorca-Puls et al. 2021). In our study, there were six subjects with cerebellum lesions.

According to a study conducted by Flowers et al. (2013), pontine lesions generally do not cause aphasia. Two of the five subjects in our study who had pontine lesions additionally exhibited frontal lobe lesions. The remaining three subjects also showed the presence of lesions in the basal ganglia (2 subjects) as well as the corona radiata and thalamus (1 subject).

Lesions in the corpus callosum have been reported to cause aphasia symptoms. Symptoms of expressive aphasia may arise from infarctions of the corpus callosum and corona radiata (Lan et al. 2020). Corpus callosum activity can suppress cortical activity in the opposite hemisphere. The absence of callosal fiber can lead to interference in the left hemisphere, which in turn suppresses activity in the language areas of the opposite hemisphere (Hinkley et al. 2016)

We identified several non-specific lesions in the parieto-temporal, parietal, temporal, and parieto-occipital lobes of subjects with motor aphasia.

However, it has been discovered that these areas are more specific for sensory aphasia (Khedr et al. 2021). The different results of this study were probably caused by overlapping lesion locations or subjectivity in expert clinical assessment. Fluctuations in cerebral blood flow could also possibly contribute to these results (Walenski et al. 2022).

Lesion locations in patients with transcortical sensory aphasia

Transcortical sensory aphasia has been associated with lesions on the insula, parietal lobe, temporal lobe, frontal lobe, internal and external capsule, caudate nucleus, and basal ganglia. The core location of lesions in transcortical sensory aphasia is the watershed area. This site is located in the dominant hemisphere cortex between the parietal and temporal cortices, near Wernicke's area (Kasselimis et al. 2011, Wang et al. 2021).

In this study, subjects with transcortical sensory aphasia exhibited pontine lesions, accompanied by lesions in other locations, including the temporo-parietal lobe, internal capsule, caudate nucleus, lateral periventricular area, and centrum semiovale. In addition, subjects who had corona radiata lesions also exhibited lesions in the parietal lobe. This indicated the presence of clinical manifestations of transcortical sensory aphasia (Kasselimis et al. 2011).

Lesion locations in patients with transcortical motor aphasia

Transcortical motor aphasia has been identified as being caused by lesions in the frontal lobe. The location of the causative lesion includes the watershed area in the dominant hemisphere between the frontal lobe and the parietal lobe, as well as the anterior and superior regions of Broca's area. In addition, transcortical motor aphasia has also been associated with lesions in the centrum semiovale (Wang et al. 2021, Jianu et al. 2022).

To the best of the authors' knowledge, there has been no established association yet between transcortical motor aphasia and several lesion locations, including the parieto-temporal, parietal, temporal, parieto-occipital, and occipital lobes. Two of the research subjects with transcortical motor aphasia had lesions in the corona radiata, basal ganglia, and occipital lobe. Lesions were also found in the parieto-occipital and frontal lobes of one subject, in the temporal and frontal lobes of one additional subject, and in the cerebellum and frontal lobes of another subject. Furthermore, two subjects exhibited lesions in the external capsule, corona radiata, and basal ganglia. Subjects with lesions in the centrum semiovale had other lesions in the corona radiata, external capsule, basal ganglia, and temporal lobe. This confirmed the clinical manifestations of transcortical motor aphasia (Li et al. 2021). However, subjects with lesions in the temporo-parietal lobe and the parietal lobe only had a single lesion each. This was probably due to the subjectivity of the attending doctor.

Lesion locations in patients with global aphasia

Global aphasia is caused by large lesions that can be found in numerous locations. The lesion locations include the frontal lobe, parietal lobe, occipital lobe, insula, internal capsule, basal ganglia, thalamus, caudate and lentiform nuclei, corpus callosum, centrum semiovale, and corona radiata (Bohra et al. 2015, Kang et al. 2017, Krishna Karthik et al. 2017). As previously discussed, pontine lesions generally do not cause aphasia. However, six subjects in our study exhibited pontine lesions, accompanied by other lesions that are associated with global aphasia, i.e., the basal ganglia, frontal lobe, parietal lobe, insula, thalamus, corona radiata, external capsule, and fronto-parieto-temporal lobe.

In this study, four subjects had lesions in the cerebellum. These subjects also exhibited lesions in other locations associated with global aphasia, including the basal ganglia, corona radiata, and fronto-parieto-temporo-occipital lobe, frontal lobe, parieto-occipital lobe, and insula. In the meantime, lesions in the watershed area are more often associated with transcortical aphasia (Khedr et al. 2021). One of our research subjects, however, had a watershed area lesion along with lesions in other locations associated with global aphasia. The occipital lobe, parietal lobe, and corona radiata were among the lesion locations.

The periventricular area has been associated with automatic speech production, as was previously discussed. In contrast, it was discovered that motoric aphasia was more frequently linked to lesions in the lateral periventricular area (Jianu et al. 2022). Subjects in our research who had lesions in the lateral paraventricular area also had lesions in additional locations related to global aphasia. We have not found any association between global aphasia and lesions in the cerebral peduncle and occipital lobe from prior studies. However, our research subjects who exhibited cerebral peduncle lesions also had lesions in the fronto-parieto-temporal lobe, which is associated with global aphasia. The subjects who had occipital lobe lesions also had other lesions in other locations associated with global aphasia. The parietal, frontal lobe, basal ganglia, posterior insula, corona radiata, temporal lobe, external capsule, and lateral periventricular were among the locations of the lesions.

Lesion locations in patients with anomic aphasia

The result of our study confirmed a study conducted by Silva et al. (2020) that lesions in the temporal and parietal lobes are the underlying cause of anomic aphasia. Our research subjects who had anomic aphasia exhibited lesions in the temporal and parietal lobes. One of the subjects who had anomic aphasia also exhibited a lesion in the frontal lobe. However, there has been no established association between anomic aphasia and frontal lobe lesions. The subjectivity of the attending doctor might result in contrast findings compared to those of earlier research.

Strength and limitations

This study can provide additional data on the various types of aphasia during the COVID-19 pandemic. The findings of this study may be useful for further studies to examine the prevalence of aphasia pre- and post-pandemic. However, this study encountered limitations due to the patients' incomplete data, affecting the sample size and the different clinical interpretations of the aphasia types between the emergency room physician and the attending neurologist at the ward. The diagnosis from the attending neurologist served as the basis for the data used in this study.

CONCLUSION

Global aphasia was the most prevalent type of aphasia in this study. The causative lesions were most frequently found in the parietal lobe. The majority of ischemic stroke patients with aphasia were middle-aged men. The primary risk factors for the disorder were hypertension, diabetes, and dyslipidemia. Additionally, aphasia was often observed in ischemic stroke patients who were overweight.

Acknowledgment

We would like to thank all the staff at the Department of Neurology of the National Brain Center Prof. Dr. dr. Mahar Mardjono Hospital, Jakarta, Indonesia, for their contribution to this study.

Conflict of interest

None.

Ethical consideration

This study was approved by the Research Ethics Committee of Universitas Pembangunan Nasional “Veteran” Jakarta, Jakarta, Indonesia, with reference No. 381/IX/2022/KEPK on 1/9/2022.

Funding disclosure

None.

Author contribution

RH contributed to the conception and design, analysis and interpretation of the data, drafting of the article, provision of study materials or patients, statistical expertise, acquisition of funding, provision of administrative, technical, or logistic support, and the collection and assembly of data. AY, RM, and RV were involved in the conception and design, critical revision of the article for important intellectual content, and final approval of the article.

REFERENCES

Ardila A (2018). Participation of the Insula in Language. In Island of Reil (Insula) in the Human Brain, 123–8. Springer International Publishing, Cham. Available at: http://link.springer.com/10.1007/978-3-319-75468-0_12.

Bohra V, Khwaja G, Jain S, et al (2015). Clinicoanatomical correlation in stroke related aphasia. Annals of Indian Academy of Neurology 18, 424–429. doi: 10.4103/0972-2327.165469.

Booth JR, Wood L, Lu D, et al (2007). The role of the basal ganglia and cerebellum in language processing. Brain Research 1133, 136–44. doi: 10.1016/j.brainres.2006.11.074.

Bushnell CD, Chaturvedi S, Gage KR, et al (2018). Sex differences in stroke: Challenges and opportunities. Journal of Cerebral Blood Flow & Metabolism 38, 2179–2191. doi: 10.1177/0271678X18793324.

Couto PB, Neves V de CR, Barreto S dos S (2020). Aphasia rate and user profile in a public referral hospital. Audiology - Communication Research. doi: 10.1590/2317-6431-2020-2288.

Døli H, Andersen Helland W, Helland T, et al (2021). Associations between lesion size, lesion location and aphasia in acute stroke. Aphasiology 35, 745–763. doi: 10.1080/02687038.2020.1727838.

Duron L, Lecler A, Cătălin Jianu D, et al (2022). Imaging of vascular aphasia. In Aphasia Compendium. IntechOpen. Available at: https://www.intechopen.com/chapters/79728.

Feigin VL, Norrving B, Mensah GA (2017). Global burden of stroke. Circulation Research 120, 439–448. doi: 10.1161/CIRCRESAHA.116.308413.

Fitri FI, Lastri DN (2019). Gambaran sindrom afasia kronik dan perubahannya pasca terapi. Majalah Kedokteran Nusantara: The Journal of Medical School. Available at: https://talenta.usu.ac.id/tjms

/article/view/3227.

Flowers HL, Silver FL, Fang J, et al (2013). The incidence, co-occurrence, and predictors of dysphagia, dysarthria, and aphasia after first-ever acute ischemic stroke. Journal of Communication Disorders 46**,** 238–248. doi: 10.1016/j.jcomdis.2013.04.001.

Fong MWM, Van Patten R, Fucetola RP (2019). The factor structure of the boston diagnostic aphasia examination, third edition. Journal of the International Neuropsychological Society 25**,** 772–776. doi: 10.1017/S1355617719000237.

Froio NL, Montgomery RM, David-Neto E, et al (2017). Anticoagulation in acute ischemic stroke: A systematic search. Revista da Associação Médica Brasileira 63**,** 50–56. doi: 10.1590/1806-9282.63.01.50.

Giulio P (2020). Aphasia: Definition, clinical contexts, neurobiological profiles and clinical treatments. Annals of Alzheimer's and Dementia Care 21–26. doi: 10.17352/aadc.000014.

Grönberg A, Henriksson I, Stenman M, et al (2022). Incidence of aphasia in ischemic stroke. Neuroepidemiology 56**,** 174–182. doi: 10.1159/000524206.

Hasanah N El (2017). Insidensi afasia pada pasien stroke akut yang dirawat inap di Rsu Haji Medan pada bulan September-Desember Tahun 2016 (thesis). Universitas Muhammdiyah Sumatera Utara. Available at: http://repository.umsu.ac.id/bitstream/handle/123456789/170/Insidensi Afasia Pada Pasien Stroke Akut Yang Dirawat Inap Di Rsu Haji Medan Pada Bulan September-Desember Tahun 2016.pdf?sequence=1&isAllowed=y

Hinkley LBN, Marco EJ, Brown EG, et al (2016). The contribution of the corpus callosum to language lateralization. The Journal of Neuroscience 36**,** 4522–4533. doi: 10.1523/JNEUROSCI.3850-14.2016.

IBM Corp. 2017. IBM SPSS Statistics for Mac, Version 25.0. Armonk, NY: IBM Corp.

Jianu DC, V. Ilic T, Nina Jianu S, et al (2022). A comprehensive overview of broca's aphasia after ischemic stroke. In Aphasia Compendium. IntechOpen. Available at: https://www.intechopen.com/chapters/79833.

Kang EK, Sohn HM, Han M-K, et al (2017). Subcortical aphasia after stroke. Annals of Rehabilitation Medicine 41**,** 725. doi: 10.5535/arm.2017.41.5.725.

Kasselimis D, Cheimariou S, Potagas C, et al (2011). Transcortical sensory aphasia after extensive left perisylvian lesion: A case of mixed dominance. Procedia - Social and Behavioral Sciences 23**,** 236–237. doi: 10.1016/j.sbspro.2011.09.256.

Khedr EM, Abbass MA, Soliman RK, et al (2021). Post-stroke dysphagia: frequency, risk factors, and topographic representation: hospital-based study. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery 57**,** 23. doi: 10.1186/s41983-021-00281-9.

Kleindorfer DO, Towfighi A, Chaturvedi S, et al (2021). 2021 guideline for the prevention of stroke in patients with stroke and transient ischemic attack: A guideline from the American Heart Association/American Stroke Association. Stroke; doi: 10.1161/STR.0000000000000375.

Krishna Karthik D, Khardenavis V, Kulkarni S, et al (2017). Global aphasia in a case of bilateral frontal lobe infarcts involving both caudate nuclei. BMJ Case Reports bcr-2017-221642. doi: 10.1136/bcr-2017-221642.

Lan R, Ma Y, Shen X, et al (2020). Bilateral corpus callosum and corona radiata infarction due to cerebral venous sinus thrombosis presenting as headache and acute reversible aphasia: a rare case report. BMC Neurology 20**,** 249. doi: 10.1186/s12883-020-01829-7.

Lee RC, Lee MH, Wu CC, et al (2018). Cerebral ischemia and neuroregeneration. Neural Regeneration Research 13**,** 373. doi: 10.4103/1673-5374.228711.

Li T, Ma J, Hong S, et al (2021). Childhood ischaemic stroke in the basal ganglia can lead to fine motor and anxiety disorders: a retrospective analysis and follow-up of 109 cases. BMC Neurology 21**,** 84. doi: 10.1186/s12883-021-02112-z.

Lorca-Puls DL, Gajardo-Vidal A, Oberhuber M, et al (2021). Brain regions that support accurate speech production after damage to Broca's area. Brain Communications. doi: 10.1093/braincomms/fcab230.

Ministry of Health of the Republic of Indonesia (2014). Profil kesehatan Indonesia tahun 2013. Kemenkes. Available at: https://repository.kemkes.go.id/book/109.

Ministry of Health of the Republic of Indonesia (2019a). Laporan nasional RISKESDAS 2018. Kemenkes. Available at: https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan Riskesdas 2018 Nasional.pdf.

Ministry of Health of the Republic of Indonesia (2019b). Pedoman nasional pelayanan kedokteran tata laksana stroke. Available at: https://yankes.kemkes.go.id/unduhan/fileunduhan_1610420235_482259.pdf.

Mitchell AB, Cole JW, McArdle PF, et al (2015). Obesity increases risk of ischemic stroke in young adults. Stroke 46**,** 1690–1692. doi: 10.1161/STROKEAHA.115.008940.

Mitchell C, Gittins M, Tyson S, et al (2021). Prevalence of aphasia and dysarthria among inpatient stroke survivors: describing the population, therapy provision and outcomes on discharge. Aphasiology 35**,** 950–960. doi: 10.1080/02687038.2020.1759772.

Mubasher SS, Batool H, Kierian EU, et al (2021). Prevalence, risk factors, and management of stroke in patients with COVID-19 infection: A review. Journal of Advances in Medical and Pharmaceutical Sciences 10–17. doi: 10.9734/jamps/2021/v23i730245.

Nabila SN, Astari R., Purwani LE (2020). Perbedaan status gizi pasien stroke iskemik dan stroke hemoragik di RSUP Fatmawati Tahun 2018. Prosiding Seminar Nasional Riset Kedokteran (Sensorik). Available at: https://conference.upnvj.ac.id/index.php/sensorik/article/view/439/592.

Pan B, Jin X, Jun L, et al (2019). The relationship between smoking and stroke. Medicine (Baltimore) 98, e14872. doi: 10.1097/MD.0000000000014872.

Rangus I, Fritsch M, Endres M, et al (2022). Frequency and phenotype of thalamic aphasia. Journal of Neurology 269, 368–376. doi: 10.1007/s00415-021-10640-4.

Rasyid A, Harris S, Kurniawan M, et al (2019). Blood viscosity as a determining factor of ischemic stroke outcomes evaluated with NIHSS and MRS on day 7 and 30 post- thrombolysis. International Journal of Pharmacy and Pharmaceutical Sciences 73–79. doi: 10.22159/ijps.2019v11i9.34820.

Setia M (2016). Methodology series module 3: Cross-sectional studies. Indian Journal of Dermatology 61, 261. doi: 10.4103/0019-5154.182410.

Silva BN, Khan M, Wijesinghe RE, et al (2020). Development of computer-aided semi-automatic diagnosis system for chronic post-stroke aphasia classification with temporal and parietal lesions: A pilot study. Applied Sciences 10, 2984. doi: 10.3390/app10082984.

Silveri MC (2021). Contribution of the cerebellum and the basal ganglia to language production: Speech, word fluency, and sentence construction—evidence from pathology. The Cerebellum 20, 282–294. doi: 10.1007/s12311-020-01207-6.

Sofyan AM, Sihombing IY, Hamra Y (2013). Hubungan umur, jenis kelamin, dan hipertensi dengan kejadian stroke. MEDULA (Scientific Journal of Medical Faculty of Halu Oleo University) 1, 24–30. doi: 10.46496/medula.v1i1.182.

Spence JD, de Freitas GR, Pettigrew LC, et al (2020). Mechanisms of stroke in COVID-19. Cerebrovascular Diseases 49, 451–458. doi: 10.1159/000509581.

Utomo TY (2022). Hubungan faktor risko terhadap kejadian stroke pada penderita corona virus diseases-2019. Syntax Literate: Jurnal Ilmiah Indonesia 7, 3841–3850. Available at: https://www.jurnal.syntaxliterate.co.id/index.php/syntax-literate/article/view/6691/4074.

Vilela P, Rowley HA (2017). Brain ischemia: CT and MRI techniques in acute ischemic stroke. European Journal of Radiology 96, 162–172. doi: 10.1016/j.ejrad.2017.08.014.

Walenski M, Chen Y, Litcofsky KA, et al (2022). Perilesional perfusion in chronic stroke-induced aphasia and its response to behavioral treatment interventions. Neurobiology of Language 3, 345–363. doi: 10.1162/nol_a_00068.

Wang Y, Du W, Yang X, et al (2021). Diagnosis and differential diagnosis flow diagram of Chinese post-stroke aphasia types and treatment of post-stroke aphasia. Aging Medicine 4, 325–336. doi: 10.1002/agm2.12183.