

Research Article

INTERNATIONAL RESEARCH JOURNAL OF PHARMACY



www.irjponline.com

ISSN 2230-8407 [LINKING]

RELATIONSHIP BETWEEN RADIOLOGY AND ISCHEMIC STROKE

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How to cite: Kiran G, Ravinandan GS. Relationship between radiology and ischemic stroke. International Research Journal of Pharmacy. 2021;12:5:39-44.

Doi: 10.7897/2230-8407.1205139

ABSTRACT

Background: Acute ischemic stroke is a major cause of death and morbidity worldwide, with developing countries like India having the highest frequency. Studying the two types of stroke—anterior circulation infarction (ACI) and posterior circulation infarction (PCS)—is crucial since they both have unique radiological and clinical characteristics.

Aim: The purpose of this study was to evaluate the radiological connection between ischemic strokes of the anterior and posterior circulations.

Methods: Out of the 208 participants in the study, 60 experienced a posterior circulation stroke, whereas 148 experienced an anterior circulation stroke. Every participant had a thorough medical history taken, followed by a thorough clinical examination, a CT scan for those who had a transient ischemic stroke (lasting less than 24 hours), and hematological testing.

Results: The study found that radiological findings in the anterior circulation {Basal ganglia vs. Frontal and Parietal vs. Frontal vs. Internal capsule vs. Parietal vs. Parietal and temporal vs. Temporal} were similar to the distribution of smoking, systemic hypertension, diabetes mellitus, alcohol, atrial fibrillation, and coronary artery disease.

Conclusion: ACS and PCS have varying radiological profiles. ACS primarily presents with motor deficits, whereas, PCS has characteristic of non-motor symptoms such as visual disturbances, headache, and ataxia.

Keywords: stroke, risk factors, radiographic association, anterior and posterior circulation infarction

INTRODUCTION

Stroke is the most frequent neurological ailment that can be fatal. It accounts for one out of every 15 fatalities and ranks third in terms of fatality, after heart disease and cancer. Stroke is the leading cause of impairment requiring long-term hospitalization in the elderly, the demographic where it occurs most frequently. When a patient has an acute stroke, the medical staff should determine the cause, evaluate the severity of the stroke, take into account any potential recurrence or progression, and look for measures to stabilize or reverse the stroke.¹

In order to help clinicians subcategorize patients at three different levels that distinguish stroke from non-stroke cases, such as subdural hematoma and cerebral tumors that differentiate hemorrhage from infarction and identify particular pathophysiological subtypes in subjects with cerebral infarction, a variety of investigations that are conducted to assess stroke at its early stage must be carried out. Rapid attempts must be made to diagnose stroke and its mechanism using this strategy because of the considerable risk of recurrence or worsening.^{2,3}

The ideal test for diagnosing a stroke should be non-invasive, affordable, accurate, accessible, and educational. A radiographic evaluation of the wounded site using MRI (magnetic resonance imaging) or CT (computed tomography) is the first testing step at the majority of institutes. Compared to MRI imaging, CT scanning is a non-invasive, easily accessible, and reasonably priced treatment at many institutions.⁴

It is feasible to draw a reasonable judgment about the type of stroke and its location of origin by examining the modest symptoms and the topographical pattern of brain tissue affection; this would be quite beneficial for our ongoing care.

MATERIALS AND METHODS

Assessing the radiological association between anterior and posterior circulation ischemic stroke was the goal of the current observational investigation. The study participants came from the Institute's Department of Neurosurgery. Prior to their involvement in the study, all subjects gave their written and verbal informed consent.

The following formula was used to determine the study's sample size: The following formula was used to estimate the necessary sample size, which is 104. where p = population proportion = $(P_1 + P_2)$ and N = number of samples r = two group ratio ratio = 1. The desired power is $Z_{1-\beta} = 0.84$ for 80% power. P_1 = First Group Proportion in cases = 60% P_2 = Second Group Proportion in cases = 40.8% $Z_{1-\alpha/2}$ = Critical value and a standard value for the corresponding = 1.96 at 95% CI Then $n = 104$.

Participants had to be older than 14 years old, hospitalized to a general medicine ward, and have a focal neurological deficit of vascular origin (ischemic) that started suddenly and lasted longer than 24 hours in order to be eligible for the study. Subjects under the age of 14, hemorrhagic strokes, venous strokes, head trauma, malignancies of the central nervous system, neuroinfection resulting in paralysis, and subdural bleeding were all excluded from the study.

A thorough history was taken of each participant, followed by a thorough clinical assessment for those who had a transient ischemic stroke (lasting less than twenty-four hours), hematological testing, and a CT scan.

A systematic schedule (case report form) was used to gather data from the study participants, which was then put into a Microsoft Excel sheet. ANOVA, the chi-square test, the student's t-test, Fisher's exact test, the Mann Whitney U test, and SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk, NY, USA) were used to statistically evaluate the collected data. A p-value of less than 0.05 was regarded as the significance level.

RESULTS

Assessing the radiological association between anterior and posterior circulation ischemic stroke was the goal of the current observational investigation. Table 1 lists the study participants' demographic information. The study's findings demonstrated that radiological findings in the anterior circulation were comparable to the distribution of smoking, systemic hypertension, diabetes mellitus, alcohol, atrial fibrillation, and coronary artery disease.

(Smoking 33.33% vs 0.00% vs 26.67% vs 0.00% vs 14.29% vs 48.48% vs 33.33% respectively (p value=0.416), Systemic hypertension 41.67% vs 100.00% vs 53.33% vs 66.67% vs 85.71% vs 69.70% vs 33.33% respectively (p value=0.324), Diabetes mellitus 33.33% vs 0.00% vs 26.67% vs 33.33% vs 28.57% vs 33.33% vs 66.67% respectively (p value=0.933), Alcohol 25.00% vs 0.00% vs 40.00% vs 33.33% vs 28.57% vs 27.27% vs 0.00% respectively (p value=0.905), Atrial fibrillation 0.00% vs 0.00% vs 6.67% vs 0.00% vs 14.29% vs 0.00% vs 33.33% respectively (p value=0.082), Coronary artery disease 8.33% vs 0.00% vs 13.33% vs 0.00% vs 42.86% vs 27.27% vs 0.00% respectively (p value=0.475)).

Parietal patients had a considerably greater percentage of high plasma lipid patients (42.86%) (p value=0.023) (Table 2). The radiological results in the anterior circulation (Basal ganglia vs. Frontal and Parietal vs. Frontal vs. Internal capsule vs. Parietal vs. Parietal and temporal vs. Temporal) were similar to the distribution of symptoms.

(Headache: 16.67% vs 100.00% vs 33.33% vs 0.00% vs 0.00% vs 30.30% vs 66.67% respectively (p value=0.135), Vertigo: 33.33% vs 0.00% vs 6.67% vs 0.00% vs 14.29% vs 9.09% vs 33.33% respectively (p value=0.285), Nausea, vomiting 0.00% vs 100.00% vs 20.00% vs 0.00% vs 28.57% vs 18.18% vs 33.33% respectively (p value=0.162), Seizure 8.33% vs 100.00% vs 40.00% vs 33.33% vs 14.29% vs 18.18% vs 33.33% respectively (p value=0.177), Ataxia 0.00% vs 0.00% vs 0.00% vs 0.00% vs 3.03% vs 0.00% respectively (p value=1), Aphasia 33.33% vs 0.00% vs 60.00% vs 33.33% vs 14.29% vs 42.42% vs 66.67% respectively (p value=0.414),

Altered sensorium 50.00% vs 100.00% vs 53.33% vs 0.00% vs 28.57% vs 72.73% vs 66.67% respectively (p value=0.068), Hemi sensory loss 41.67% vs 100.00% vs 33.33% vs 66.67% vs 28.57% vs 42.42% vs 0.00% respectively (p value=0.619), Dysarthria 8.33% vs 0.00% vs 6.67% vs 0.00% vs 0.00% vs 6.06% vs 0.00% respectively (p value=1), Swallowing difficulty 16.67% vs 100.00% vs 20.00% vs 33.33% vs 0.00% vs 12.12% vs 0.00% respectively (p value=0.28), Quadriplegia 8.33% vs 0.00% vs 20.00% vs 0.00% vs 0.00% vs 6.06% vs 0.00% respectively (p value=0.655), Hemiparesis or hemiplegia 75.00% vs 100.00% vs 66.67% vs 100.00% vs 85.71% vs 93.94% vs 100.00% respectively (p value=0.184), 7th cranial nerve 8.33% vs 0.00% vs 20.00% vs 33.33% vs 14.29% vs 33.33% vs 0.00% respectively (p value=0.567), Visual field defect 0.00% vs 0.00% vs 6.67% vs 0.00% vs 0.00% vs 0.00% vs 33.33% respectively (p value=0.116)) (Table 3).

The distribution of risk factors and the radiological results in the posterior circulation were similar. {Cerebellum vs. Medulla vs. Occipital vs. Mid brain vs. Pons} (Smoking: - 40.00% vs. 100.00% vs. 50.00% vs. 55.56% respectively (p value=0.866), Systemic hypertension: - 73.33% vs. 0.00% vs. 25.00% vs. 100.00% vs. 77.78% respectively (p value=0.139), diabetes mellitus: - 46.67% vs. 0.00% vs. 50.00% vs. 0.00% vs. 11.11% respectively (p value=0.305), High plasma lipid: - 33.33% vs 0.00% vs. 50.00% vs. 0.00% vs. 33.33% respectively (p value=0.944), Alcohol: - 13.33% vs 0.00% vs 25.00% vs 100.00% vs. 11.11% respectively (p value=0.345),

Atrial fibrillation 6.67% vs 0.00% vs 0.00% vs 0.00% vs 11.11% respectively (p value=1), coronary artery disease 26.67% vs 0.00% vs 50.00% vs 0.00% vs 22.22% respectively (p value=0.848)) (Table 4).

Distribution of headache, vertigo, nausea, vomiting, seizure, aphasia, altered sensorium, hemi sensory loss, dysarthria, swallowing difficulty, quadriplegia, hemiparesis or hemiplegia, nystagmus, cross hemiplegia, 7th cranial nerve was comparable with radiological findings in posterior circulation {Cerebellum vs Medulla vs Occipital vs Mid brain vs Pons}. (Headache 46.67% vs 0.00% vs 75.00% vs 100.00% vs 33.33% respectively (p value=0.428), Vertigo 60.00% vs 0.00% vs 50.00% vs 100.00% vs 44.44% respectively (p value=0.866), Nausea, vomiting 46.67% vs 0.00% vs 0.00% vs 100.00% vs 55.56% respectively (p value=0.213), Seizure 13.33% vs 0.00% vs 50.00% vs 0.00% vs 11.11% respectively (p value=0.516), Aphasia 20.00% vs 0.00% vs 0.00% vs 0.00% vs 44.44% respectively (p value=0.517), Altered sensorium 33.33% vs 0.00% vs 75.00% vs 0.00% vs 77.78% respectively (p value=0.076), Hemi sensory loss 20.00% vs 100.00% vs 50.00% vs 100.00% vs 33.33% respectively (p value=0.177), Dysarthria 33.33% vs 0.00% vs 25.00% vs 0.00% vs 22.22% respectively (p value=0.922), Swallowing difficulty 26.67% vs 100.00% vs 0.00% vs 0.00% vs 44.44% respectively (p value=0.247), Quadriplegia 6.67% vs 0.00% vs 0.00% vs 0.00% vs 44.44% respectively (p value=0.146), Hemiparesis or hemiplegia 40.00% vs 100.00% vs 75.00% vs 100.00% vs 55.56% respectively (p value=0.565), Nystagmus 26.67% vs 0.00% vs 0.00% vs 0.00% vs 33.33% respectively (p value=0.828), Cross hemiplegia 6.67% vs 0.00% vs 0.00% vs 0.00% vs 22.22% respectively (p value=0.767), 7th cranial nerve 6.67% vs 0.00% vs 0.00% vs 0.00% vs 22.22% respectively (p value=0.767)).

The midbrain had a substantially higher percentage of patients with ataxia (100.00%) (p value=0.029). Occipital patients had a considerably higher percentage of diplopia (50.00%) (p value=0.034). The midbrain had a substantially greater percentage of patients with visual field defects (100.00%) (p value=0.046) (Table 5).

DISCUSSION

The study comprised 104 individuals over the age of 14 who were hospitalized to a general medicine ward with a focal neurological deficit of vascular origin (ischemic) that started suddenly and lasted longer than 24 hours. Anterior and posterior circulation ischemic stroke risk variables and clinical profiles were evaluated. The most common cause of neurological disorders in adults is stroke.

We can enhance primary and secondary prevention interventions by understanding the clinical features and prevalence of risk factors in both stroke subtypes. The most common neurological condition in adults is cerebrovascular illness. To enhance main and secondary preventative measures, it is critical to comprehend the risk factors linked to different stroke subtypes. Due to their distinct underlying pathophysiology, natural histories, risk factors, clinical characteristics, and response to treatment, these stroke subtypes are now frequently regarded as distinct entities.

The study's findings demonstrated that radiological findings in the anterior circulation {Basal ganglia vs. Frontal and Parietal vs. Frontal vs. Internal capsule vs. Parietal vs. Parietal and temporal vs. Temporal} were comparable to the distribution of smoking, systemic hypertension, diabetes mellitus, alcohol, atrial fibrillation, and coronary artery disease. Systemic hypertension: 41.67% vs. 100.00% vs. 53.33% vs. 66.67% vs. 85.71% vs. 69.70% vs. 33.33% (p value=0.324); smoking: 33.33% vs. 0.00% vs. 26.67% vs. 33.33% vs. 28.57% vs. 33.33% vs. 66.67% (p value=0.933).

The percentage of parietal patients with elevated plasma lipid was substantially greater (42.86%) (p value=0.023). This was in line with research by Lee et al.⁵ and Mousavi et al.⁶, who discovered that smoking increases the risk of stroke mostly due to large-artery atherosclerosis. In younger people, smoking may also be a contributing factor to stroke. Similar to the current study, smoking is a risk factor for posterior circulation strokes more often than anterior circulation strokes, according to studies by Subramanian et al.⁷ and El Sherif et al.⁸.

Neuroimaging is still essential for diagnosing strokes, especially when separating ACS from PCS. The sensitivity and specificity of the clinical diagnosis based on symptom complexes in this investigation were 95.16% and 77.14% for ACS and 92.86% and 94.20%, respectively, for PCS. These findings highlight the value of both radiological confirmation and clinical evaluation. The study does point out, though, that a clinical diagnosis by itself may not always be enough, especially in the case of PCS, when brainstem and cerebellar strokes are frequently overlooked based solely on clinical criteria.⁹

This study's use of magnetic resonance imaging (MRI) and computed tomography (CT) complied with current guidelines for diagnosing AIS. While PCS was linked to infarcts in the posterior cerebral artery (PCA) and vertebrobasilar systems, radiological confirmation of ACS revealed lesions primarily in the middle cerebral artery (MCA) area. Since posterior circulation strokes frequently manifest without obvious neurological abnormalities, the great sensitivity of imaging methods such as diffusion-weighted imaging (DWI) and CT angiography (CTA) is especially helpful in diagnosing these conditions.^{10,11}

The results of this investigation are consistent with earlier studies on the distinctions between PCS and ACS. Elodie Zurcher et al. discovered that while ACS patients show more severe motor deficits and higher NIHSS scores, PCS patients tend to have lower NIHSS scores at admission and are more likely to present with cognitive symptoms, vestibulo-cerebellar signs, and visual disturbances. According to De Marchis et al. (2013), patients with PCS typically have more modest symptoms, which makes diagnosis difficult. They support the proactive use of imaging in patients whose clinical presentations are unclear.

CONCLUSION

The present study, within its limitations, concludes that ACS and PCS have varying radiological profiles. ACS primarily presents with motor deficits, whereas, PCS has characteristic of non-motor symptoms such as visual disturbances, headache, and ataxia. Radiological imaging remains vital for confirming the diagnosis, especially in subjects with PCS. Early identification and targeted therapy can improve outcomes in stroke subjects, which emphasize on the need for detailed clinical and imaging assessments in stroke management.

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Characteristics	N=208 (%)	Anterior circulation (n=148)	Posterior circulation (n=60)	p-value
Mean age (years)	59.12±12.3	60.24±12.04	56.3±11.94	
Age range (years)				
20-30	2 (0.96)	0	2 (0.96)	0.484
31-40	12 (5.77)	8 (5.41)	12 (5.77)	
41-50	38 (15.27)	30 (20.27)	8 (13.33)	

51-60	68 (32.69)	42 (28.38)	26 (43.33)	
61-70	58 (27.88)	44 (29.73)	14 (23.33)	
71-80	24 (11.54)	18 (12.16)	6 (10)	
81-90	6 (2.88)	6 (4.05)	0	
Gender				
Males	140 (67.31)	92 (62.16)	48 (80)	0.08
Females	68 (32.69)	56 (37.84)	12 (20)	
Systolic blood pressure (mmHg)	136.04±23.74	136±22.24	131.25±26.90	0.194
Diastolic blood pressure (mmHg)	83.79±12.2	85.20±11.47	80.31±14.04	0.07
Fasting blood glucose (mg/dl)	108.17±67.9	108.21±68.93	108.07±67.07	0.994
Triglycerides (mg/dl)	135.62±54.66	130.12±47.91	149.21±67.56	0.164
Serum cholesterol (mg/dl)	166.39±32.06	165.34±31.76	169±33.19	0.601

Table 1: Demographic characteristics in study subjects

Risk factors	Frontal (n=15)	Parietal (n=7)	Temporal (n= 3)	Parietal and temporal (n=33)	Frontal and Parietal (n=1)	Internal capsule (n=3)	Basal ganglia (n=12)	Total	P-value
Smoking	4 (26.67)	1 (14.29)	1 (33.33)	16 (48.48)	0	0	4 (33.33)	26 (35.1)	0.416*
Systemic hypertension	8 (53.33)	6 (85.71)	1 (33.33)	23 (69.70)	1 (100)	2 (66.67)	5 (41.67)	46 (62.1)	0.324*
Diabetes mellitus	4 (26.67)	2 (28.57)	2 (66.67)	11 (33.33)	0	1 (33.33)	4 (33.33)	24 (32.4)	0.933*
High plasma Lipid	1 (6.67)	3 (42.86)	1 (33.33)	1 (3.03)	0	1 (33.33)	2 (16.67)	9 (12.16)	0.023*
Alcohol	6 (40)	2 (28.57)	0	9 (27.27)	0	1 (33.33)	3 (25)	21 (28.3)	0.905*
Atrial fibrillation	1 (6.67)	1 (14.29)	1 (33.33)	0	0	0	0	3 (4.05)	0.082*
Coronary artery disease	2 (13.3)	3 (42.86)	0	9 (27.27)	0	0	1 (8.33)	15 (20.27)	0.475*

Table 2: Association of risk factors with radiological findings in anterior circulation

Symptoms	Frontal (n=15)	Parietal (n=7)	Temporal (n= 3)	Parietal and temporal (n=33)	Frontal and parietal (n=1)	Internal capsule (n=3)	Basal ganglia (n=12)	Total	P-value
Headache	5 (33.33)	0	2 (66.67)	10 (30.30)	1 (100)	0	2 (16.67)	20 (27.03)	0.135*
Vertigo	1 (6.67)	1 (14.29)	1 (33.33)		0	0	4 (33.33)	10 (13.51)	0.285*
Nausea, vomiting	3 (20)	2 (28.57)	1 (33.33)		1 (100)	0	0	13 (17.57)	0.162*
Seizure	6 (40)	1 (14.29)	1 (33.33)		1 (100)	1 (33.33)	1 (8.33)	17 (22.97)	0.177*
Ataxia	0	0	0	1 (3.03)	0	0	0	1 (1.35)	1*
Aphasia	9 (60)	1 (14.29)	2 (66.67)		0	1 (33.33)	4 (33.33)	31 (41.89)	0.414*
Altered sensorium	8 (53.33)	2 (28.57)	2 (66.67)		1 (100)	0	6 (50)	43 (58.11)	0.068*
Hemi sensory Loss	5 (33.33)	2 (28.57)	0	14 (42.42)	1 (100)	2 (66.67)	5 (41.67)	29 (39.19)	0.619*
Dysarthria	1 (6.67)	0	0		0	0	1 (8.33)	4 (5.41)	1*

Table 3: Association of symptoms with radiological findings in anterior circulation

Risk factors	Occipital (n=4)	Mid Brain (n=1)	Pons (n=9)	Medulla (n=1)	Cerebellum (n=15)	Total	P-value
Smoking	2 (50)	0	5 (55.56)	1 (100)	6 (40)	14(46.67)	0.866*
Systemic hypertension	1 (25)	1 (100)	7 (77.78)	0	11 (73.33)	20 (66.6)	0.139*
Diabetes mellitus	2 (50)	0	1 (11.11)	0	7 (46.67)	10(33.33)	0.305*
High plasma lipid	2 (50)	0	3 (33.33)	0	5 (33.33)	10(33.33)	0.944*

Alcohol	1 (25)	1 (100)	1 (11.11)	0	2 (13.33)	5 (16.67)	0.345*
Atrial fibrillation	0	0	1 (11.11)	0	1 (6.67)	2 (6.67)	1*
Coronary artery disease	2 (50)	0	2 (22.22)	0	4 (26.67)	8 (26.67)	0.848*

Table 4: Association of risk factors with radiological findings in posterior circulation

Symptoms	Occipital (n=4)	Mid Brain (n=1)	Pons (n=9)	Medulla (n=1)	Cerebellum (n=15)	Total	P-value
Headache	3 (75)	1 (100)	3 (33.33)	0	7 (46.67)	14 (46.67)	0.428*
Vertigo	2 (50)	1 (100)	4 (44.44)	0	9 (60)	16 (53.33)	0.866*
Nausea, vomiting	0	1 (100)	5 (55.56)	0	7 (46.67)	13 (43.33)	0.213*
Seizure	2 (50)	0	1 (11.11)	0	2 (13.33)	5 (16.67)	0.516*
Ataxia	1 (25)	1 (100)	0	0	7 (46.67)	9 (30)	0.029*
Aphasia	0	0	4 (44.44)	0	3 (20)	7 (23.33)	0.517*
Altered sensorium	3 (75)	0	7 (77.78)	0	5 (33.33)	15 (50)	0.076*
Hemi sensory Loss	2 (50)	1 (100)	3 (33.33)	1 (100)	3 (20)	10 (33.33)	0.177*
Dysarthria	1 (25)	0	2 (22.22)	0	5 (33.33)	8 (26.67)	0.922*
Swallowing difficulty	0	0	4 (44.44)	1 (100)	4 (26.67)	9 (30)	0.247*
Quadripareisis	0	0	4 (44.44)	0	1 (6.67)	5 (16.67)	0.146*
Hemiparesis hemiplegia	3 (75)	1 (100)	5 (55.56)	1 (100)	6 (40)	16 (53.33)	0.565*
Nystagmus	0	0	3 (33.33)	0	4 (26.67)	7 (23.33)	0.828*
Diplopia	2 (50)	0	0	0	0	2 (6.67)	0.034*
Cross hemiplegia	0	0	2 (22.22)	0	1 (6.67)	3 (10)	0.767*
7 th cranial nerve	0	0	2 (22.22)	0	1 (6.67)	3 (10)	0.767*
Visual field defect	3 (75)	1 (100)	2 (22.22)	0	2 (13.33)	8 (26.67)	0.046*

Table 5: Association of symptoms with radiological findings in posterior circulation