

## Study of Risk Factors, Clinical, Radiological Profile in Posterior Circulation Stroke

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### ABSTRACT

**Background:** Stroke can be due to ischemia or hemorrhage. 80% of strokes are due to an ischemic event. Out of these, 20% are posterior circulation stroke. Posterior circulation is more prone to atherosclerosis like systemic arteries compared to the intracranial part of anterior circulation.

**Material & Methods:** This study was carried out in patients who presented with signs and symptoms of PC stroke to the medicine and neurology department of Darbhanga Medical College and Hospital, Laheriasarai, Bihar. The study was conducted during the time period of January 2021 to October 2021. The stroke events were classified according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification.

**Results:** Males were commonly affected than female. The most common age group was between 40-60 years. The most common risk factor for PC stroke in our population was hypertension, followed by smoking and diabetes. The most common clinical presentation was vertigo, followed by ataxia and motor weakness. Distal territory involvement was most common in our study, followed by proximal and middle vascular territories. In posterior circulation, stroke ischemic was more common than hemorrhagic. The common isolated site of involvement in posterior circulation ischemic stroke was the cerebellum followed by the occipital lobe, and the most common site of bleed in PC stroke was the cerebellum. Study found a higher percentage of large artery disease, followed by cardio embolism as a cause of posterior circulation stroke.

**Conclusion:** Our study demonstrated the occurrence of posterior circulation stroke in a relatively younger age group compared to case series from the Western world. We found a higher percentage of large artery disease as a cause of posterior circulation stroke with distal territory involvement.

**Key Words:** Posterior circulation, stroke, risk factors

### INTRODUCTION

Globally, 1.8 million people suffer from stroke every year, and it is the leading cause of death next to coronary vascular disease<sup>1</sup>. In India, it is the leading cause of death, bypassing cardiac problems, and TB. We should understand that 'time is brain' and plug the gaps (lack of awareness, delay in arrival, and lack of centers offering thrombolysis). 50% of all neurological disorders in a tertiary care hospital are due to stroke.

C. M. Fisher, a renowned neurologist said, neurology is learned stroke by stroke. Stroke can be due to ischemia or hemorrhage. 80% of strokes are due to an ischemic event<sup>2</sup>. Out of these, 20% are posterior circulation stroke. The posterior circulation stroke involving the vertebrobasilar artery is devastating, and some forms can cause high morbidity and mortality. Most of the PC strokes were incorrectly diagnosed or undiagnosed. The term VBI was used in the past to indicate hemodynamic alterations caused by posterior circulation stroke.

During the last 15 years, various clinical studies<sup>2-6</sup>, and brain imaging information have revolutionized understanding of the clinical profile, pathophysiology, treatment, prognosis of posterior circulation stroke.

PC stroke's etiology thought to be due to large artery disease (atherosclerosis) or penetrating artery disease (lacunar stroke). However, there is increasing evidence that cardio-embolic stroke was more common than suspected previously, which accounts for 20 to 50% of PC stroke<sup>5</sup>.

Posterior circulation is more prone to atherosclerosis like systemic arteries compared to the intracranial part of anterior circulation. If one vertebral artery is occluded, collateral circulation comes into play from the contralateral vertebral artery, posterior communicating artery, and cervical artery branches. With a better understanding of various risk factors causing the stroke, the goal should be prevention rather than management.

Objectives of the present study were to study the etiology and various clinical presentations in posterior circulation stroke and to evaluate the commonest anatomical area involved with the help of imaging modalities (CT and MRI).

## **MATERIAL AND METHODS**

This study was carried out in patients who presented with signs and symptoms of PC stroke to the medicine and neurology department of Darbhanga Medical College and Hospital, Laheriasarai, Bihar. The study was conducted during the time period of January 2021 to October 2021. All patients with signs and symptoms of posterior circulation stroke were subjected to CT scan brain in emergency department followed by ECG, CXR, ECHOCARDIOGRAM, 4 VESSEL DOPPLER, AND FASTING LIPID PROFILE, MRI brain (in selected cases) was performed in all these patients

### **INCLUSION CRITERIA:**

- Patients who had symptoms and signs of posterior circulation stroke
- Patients who had radiological evidence of posterior circulation stroke

### **EXCLUSION CRITERIA:**

- Patients with clinical features and neurotological features of labyrinthine disorders and vestibular disorders
- Patients with subarachnoid hemorrhage, extra Dural or subdural hemorrhage

A detailed clinical history was taken regarding the risk factors, mode of presentation, the time interval between onset and arrival to the hospital. Major risk factors included in this study are age, sex, hypertension, diabetes mellitus, dyslipidemia, cardiac disease, smoking, alcohol intake.

Special focus was given for clinical examination of the cardiovascular system with respect to rhythm disturbances, valvular heart disease, and cardiac failure. Detailed neurological examination was done, and the patients were grouped into posterior circulation stroke. Blood hemogram with peripheral smear, hematocrit, fasting blood sugar, lipid profile, renal function tests, an electrocardiogram was done.

Echocardiogram to rule out any left atrial appendage clots, patent foramen ovale, and vegetation to rule out a cardioembolic stroke. Radio imaging studies including CT, MRI, and Doppler Studies were done to localize the anatomical area and to correlate with clinical features.

Patients were analyzed using structured proforma for

- (1) demographics, and stroke risk factors including hypertension, diabetes mellitus, smoking, alcohol consumption, obesity, dyslipidemia, cardiac diseases, migraine, oral contraceptive use, neck trauma hyper homocysteinemia, and antiphospholipid antibody syndrome
- (2) clinical characteristics, results of neuroimaging and vascular studies describing infarct location and vascular territory involvement.

Participants who did not have any common risk factors like hypertension, diabetes, atrial fibrillation, or other cardiac illness were investigated for serum homocysteine level and antiphospholipid assay. All patients were subjected to computerized tomography (CT) scan, and or magnetic resonance imaging (MRI) following standard protocol. Infarct location was decided by clinical assessment and by neuroimaging findings. The stroke events were classified according to the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification.

The categories included -

(1) large-vessel atherosclerosis: atherosclerosis with stenosis, (2) small-vessel disease: lacunar syndrome and normal CT/MRI or relevant lesion <1.5 cm and absent source of emboli (3) cardioembolism, (4) other determined causes, (5) undetermined causes. 2 or more causes identified, negative evaluation, or incomplete evaluation.

Patients were classified into 5 subgroups according to the vascular territory involvement and distribution of infarcts on neuroimaging. These subgroups included posterior cerebral artery, superior cerebellar artery, anterior inferior cerebellar artery (AICA), posterior inferior cerebellar artery (PICA), and top of the basilar artery.

Patients were also categorized according to proximal–distal extent of infarction as “proximal intracranial” (vertebral artery-medulla; PICA-cerebellum), “middle intracranial” (basilar artery-Pons; AICA-cerebellum) and “distal intracranial” (rostral basilar artery-midbrain, thalamus; superior cerebellar artery-cerebellum; posterior cerebral artery-occipital and medial temporal lobe).

### **Statistical analysis:**

Descriptive analysis was carried out by the mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagrams and pie diagrams. Since the study was only a descriptive study, no inferential statistical analysis was performed, and no P values were reported. For statistical analysis, IBM SPSS version 22 was used.

## **RESULTS**

60 patients admitted with clinical features suggestive of posterior circulation stroke were enrolled in our study. Among 60 patients, 42 patients were males (63. 75%), and 18 were females (36.25%). The mean age was 56.31. The majority of cases were in the age group between 50 and 60, followed by 60 to 70 age group.

Risk factors- In all 60 patients, the possible risk factors were studied. 46 patients had hypertension, and 22 patients had diabetes mellitus. 25 patients gave a history of smoking. 18 patients had dyslipidemia, and 8 patients had coronary artery disease.

Clinical features- The clinical presentation at the onset of stroke was studied in which most of our patients presented with giddiness and vomiting. Headache was present in 22 patients, altered sensorium at onset was seen in 6 patients, and 8 patients had seizures. Other clinical features that were according to the territory involved included homonymous hemianopia, temporal lobe signs, cerebellar signs, motor weakness, sensory disturbances, cranial nerve neuropathy, and most of them were a combination of symptoms.

Anatomical areas involved: According to NEMC posterior circulation registry, we describe the location of posterior circulation stroke into proximal, middle, and distal intracranial arteries. The clinical features and neuroimaging were taken together to describe the location of the infarct. Among these 60 patients, we found that distal territory involvement was more common, followed by proximal. The isolated middle was less in this study. In other patients, we had a varying combination of either proximal middle or distal territory infarcts.

Distribution of patients based on anatomical location:

Out of 60 patients, 46 patients had an ischemic stroke, and 14 had a hemorrhagic stroke. Among ischemic stroke most of the patients had combined involvement of supra and infra tentorium followed by cerebellar location. In hemorrhagic stroke, the most common location was combined involvement, followed by the cerebellum.

Stroke subtype:

In our study, 73.3% of patients had large artery disease, 3.3% had small vessel disease, 11.7% had a cardio-embolic stroke, and 10% had an undetermined cause.

In our study, one patient with top of basilar artery syndrome or Locked-in syndrome (LIS) usually follows a brainstem stroke and is characterized by paralysis of all voluntary muscles (except eyes' movements or blinking) and lack of speech with preserved consciousness.

**Table : 1 Distribution of patients based on the location of territory involvement**

Territory Involvement	Frequency	Percentage
Distal	24	40%
Middle	03	5%
Proximal	20	33.3%
Combination	13	21.7%

**Table : 2 Distribution of patients based on anatomical location**

Features	Ischemic stroke (76.7%)		Hemorrhagic stroke (23.3%)	
	No. of patients	Percentage	No. of patients	Percentage
Infratentorial	3	21.7%	5	8.3%
Medulla	1	1.7%	1	1.7%
Pons	2	3.3%	1	1.7%
Midbrain	3	5%	-	-
Cerebellum	6	10%	3	5%
Supratentorial	8	13.3%	2	3.3%
Thalamic and Medial temporal	3	5%	1	1.7%
Occipital	5	8.3%	1	1.7%
Combination	26	43.3%	7	11.7%

**Table : 3** Various stroke subtypes and their distribution among patients

Stroke subtype	Frequency	Percentage
Large artery disease	44	73.3%
Small artery disease	02	3.3%
Cardio embolic stroke	07	11.7%
Other determined causes	01	1.6%
Undetermined causes	06	10%

## DISCUSSION

Posterior circulation strokes comprise 10-15% of all strokes, 80% of them being ischemic strokes. Most of the other studies have reported that 80% of strokes are ischemic, and 20% of ischemic strokes involve the posterior circulation. The Lausanne Stroke Registry and the Besancon Stroke Registry revealed the relative prevalence of posterior circulation stroke to be 26.7% and 26%, respectively. Hallym Stroke Registry (HSR) showed that posterior circulation stroke was responsible for 39.8% of all ischemic stroke. In the present study, gender distribution showed that 70% were males and 30% were female. Published data from the Tufts-New England Medical Centre, posterior circulation stroke registry document, showed that 58% of patients are male and 42% female. Incidence was more in the male population compared to females was in accordance with other studies like Ma. Cristina L et al.<sup>8</sup> study and R. B. Libman et al. study<sup>9</sup>. In our study, the majority (60%) of the patients were in the age group of 40 to 60 years. The majority of cases were in the age group between 50 and 60 yrs. The mean age was 56.31. The New England Medical Centre Posterior Circulation Registry (NEMC-PCR)<sup>10</sup> demonstrated that the majority of patients with posterior circulation stroke were in the age group ranging between 66-75 years. A stroke occurs in relatively younger people in developing countries. In our study, only 4 patients (13.3%) were older than 75 years, while in NEMC-PCR<sup>10</sup>, 27.7% of patients were in the age group ranging more than 75 years. Lower life expectancy in the Indian population compared to the Western world (66.46 vs. 78.24 years) could be the explanation for this difference.

Rawat et al.<sup>11</sup> maximum patients were in the age group 41-70 years with the mean age for males 56.52 years and for females 59.82 years, with a median age of 56.5 years. Sundar et al. study<sup>12</sup> in a tertiary care hospital found the maximum number of patients in the age group of 40-55 years, which was comparable to our study. Hypertension was the most common risk factor associated with stroke. In our study, 76.6% were hypertensives, this was comparable with the study by Lee et al<sup>13</sup>, Caplan et al<sup>10</sup>, Rawat K J<sup>11</sup> et al., where hypertension as risk factor in 69.9%, 61%, and 60.5% of patients, respectively. Smoking was found in 41.7% and was the second most common cause similar to NEMC-PCR<sup>10</sup> and Lee et al<sup>13</sup> studies. Diabetes was the third most common cause comparable to previous studies, followed by dyslipidemia seen in 30%. Whereas Kora et al<sup>14</sup>, found most common risk factor for posterior circulation stroke as tobacco abuse 52% and hypertension as the second common risk factor (37%). Less common risk factors in this study were dyslipidemia (10%), diabetes (5%), rheumatic heart disease (RHD) (5%), and Ischaemic heart disease IHD. (5%). Incidence of high tobacco abuse in kora et al<sup>14</sup>. study can be explained on the basis that tobacco abuse is more common in that part of the state. Posterior circulation stroke can have varied clinical presentations. Vertigo was the most common clinical finding in our study, reported in 63.3% of patients. Vertigo in posterior circulation stroke is due to the involvement of the vestibular nucleus or its connections. Vertigo is a predominant feature of the lateral medullary syndrome and cerebellar stroke, especially due to PICA and AICA territory

involvement. Due to the high density of nuclei and tracts in the brain stem, vertigo is usually accompanied by the involvement of other cranial nerves and or long tracts. It has been reported that isolated episodes of vertigo continuing for more than 3 weeks are almost never caused by vertebra-basilar disease. The most common clinical presentation in Rawat et al<sup>11</sup> study was ataxia (70%), followed by vertigo (62.6%). A study by Patrick et al<sup>15</sup>, found that the most common clinical presentation was cranial nerve involvement was 64%, followed by altered sensorium (47%). Kora et al<sup>11</sup>, study found the most common presentation as motor disturbance and altered sensorium (63%) patients.

In our study, 73.3% of patients had large artery disease, and 11.7% had a documented cardioembolic source. Large artery disease was present in 32% of patients in NEMC-PCR, while 40% had an embolic cause, out of which 24% had a cardiac source of embolism. Higher incidence of large artery involvement in our study could be due to the more frequent intracranial large artery atherosclerosis in Asians compared to whites.

In HSR, 5.2% of the patients had cardioembolism, and the most frequent stroke subtype was large artery disease (50%). Patients of cardio embolism are always associated with cardiac disease such as atrial fibrillation, valvular heart disease of rheumatic origin, recent valvular surgery, coronary artery disease, etc., and these comorbidities may contribute to a worse outcome.

In our study, 76.7% had an ischemic stroke, and 23.3% had a hemorrhagic stroke. In a study by Rawat et al<sup>11</sup>, 63.15% of patients had an ischemic stroke, and 36.85% patients had hemorrhagic stroke. In a study by Uma Sundar<sup>16</sup>, 77.6% of patients had an ischemic stroke, and 22.4% of patients had a hemorrhagic stroke. In the present study incidence of ischaemic stroke was more (76.7%) compared to hemorrhagic stroke (23.3%) was in accordance with other studies like Uma Sundar et al.<sup>16</sup> (77% ischaemic strokes).

The most common isolated site of infarct in posterior circulation stroke was involving cerebellum 10% followed by occipital lobe 8.3%, whereas involvement pons (5%) which were less commonly involved in the present study. The most common isolated site of bleed in posterior circulation stroke was the cerebellum (5%).

Distal vascular territory involvement was most common in our study, reported in 40% of patients followed by proximal location seen in 33.3% of cases, and multiple vascular locations are seen in 21.7%. Only 5% had middle intracranial territory involvement.

The NEMC-PCR<sup>16</sup> reported distal infarction as the most common location (40.9%). Although in comparison to the NEMC registry, our study revealed lower occurrence in the middle intracranial location. Uma et al<sup>16</sup>, also showed a predominance of distal intracranial (46%), followed by proximal intracranial (34%), vascular distribution in the posterior circulation stroke.

## CONCLUSIONS

Our study demonstrated the occurrence of posterior circulation stroke in a relatively younger age group compared to case series from the Western world. We found a higher percentage of large artery disease as a cause of posterior circulation stroke with distal territory involvement. Our data suggest that etiology, risk factors, stroke subtypes, and lesion topography in posterior circulation strokes can have regional, environmental and ethnic variations. Extensive cardiac workup and evaluation for hyper coagulable states to be done in patients presenting with features of PC stroke in younger population (40 years).

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