Imaging Evaluation of Posterior Circulation Stroke with Clinical Correlation in a Tertiary Stroke Care Centre with Rural Background

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ABSTRACT

BACKGROUND

Stroke in posterior circulation accounts for 10 - 15% of all strokes, and 80% of them are ischaemic strokes.[1] But there is a paucity of studies determining aetiopathogenetic factors and outcome in PCS (Posterior Circulation Stroke). Presentation of posterior circulation stroke is diverse that differ from strokes in anterior circulation in aetiology, clinical features, and prognosis.[2-6] we wanted to delineate, nature of stroke, pattern of anatomical involvement in PCS stroke by means of CT, and MRI, in a group of 50 random patients with posterior circulation stroke at a tertiary care hospital.

METHODS

Fifty random adult patients 40 – 80 yrs. of age presenting with posterior circulation stroke were studied over a period of one and half years. The patients were subjected to thorough clinical examination and radiological evaluation by means of CT scan and MRI. Analysis included age, sex, type of stroke, location of stroke, radiological evaluation and associated features. We tried to reach a definite diagnosis utilizing the available clinical & radiological data.

RESULTS

Out of 50 patients, 29 were Male (58%) & 21 were Female (42%) with a mean age of 59.04 +/- 7.05 yrs. 34 patients had ischaemic (68%) stroke and rest had haemorrhagic stroke. Isolated brainstem involvement was seen in maximum number of patients (44%), followed by cerebellum (36%). Out of 18 patients who experienced cerebellar stroke, 14 were ischaemic (78%) and 4 were haemorrhagic (22%) in nature. Six out of seven cases of right cerebellar hemispheric strokes were ischaemic in nature (85.71%) and eight out of 11 left cerebellar hemispheric strokes were ischaemic in nature (72.73%). Out of nine patients who experienced medullary strokes, seven were ischaemic (78%); whereas two were haemorrhagic (22%). Three of them (33.33%) had medial medullary stroke and six (66.67%) had lateral medullary strokes. 66.67% medial medullary strokes were haemorrhagic and all of lateral medullary strokes were ischaemic in nature.

CONCLUSIONS

PCS showed male predominance with a mean age 59.04 +/- 7.05 yrs. Ischaemic strokes outnumbered haemorrhagic strokes in case of PCS. The most common location of PCS was brainstem. Cerebellar ischaemic stroke was more common than haemorrhagic stroke. Pontine haemorrhage was more common in cases of brainstem haemorrhage.

KEYWORDS

PCS - Posterior Circulation Stroke, Aetiology, Symptoms, Ischaemic, Haemorrhagic

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DOI: 10.18410/jebmh/2020/401

How to Cite This Article:
Jana SG, Hazra S, Khamrui S, et al. Imaging evaluation of posterior circulation stroke with clinical correlation in a tertiary stroke care centre with rural background. J Evid Based Med Healthc 2020; 7(36), 1928-1932. DOI: 10.18410/jebmh/2020/401

Submission 28-06-2020,
Peer Review 03-07-2020,
Acceptance 02-08-2020,
Published 07-09-2020.

BACKGROUND

Stroke is a rapidly developing clinical sign of focal or global disturbance of cerebral function, with symptoms lasting 24 hours or more or leading to death, with no apparent cause other than vascular origin.[7]

Out of all strokes, posterior circulation strokes comprise 10-15%, among them 80% is ischaemic in nature.[1] The area includes brainstem, cerebellum, occipital lobes, thalami, sub-thalamus and medial temporal lobes and is supplied by two vertebral arteries, one basilar artery and two posterior cerebral arteries and their branches.[2,8] This is the only vascular region in the body where two arteries unite to form a large arterial trunk that again divides in two major branches.[3] Posterior circulation stroke presents diversely that differ from strokes in anterior circulation in relation to aetiology, clinical features, and prognosis. Presentation ranges from fluctuating brainstem symptoms caused by intermittent insufficiency, to the locked-in syndrome which is caused by basilar or bilateral vertebral artery occlusion.[2-6]

Vascular Territory of PCA

1. Most of the inferior surface of the cerebral hemisphere, except for the temporal tip and frontal lobe.
2. Occipital lobe.
3. Posterior one-third of the medial hemisphere and corpus callosum.
4. Most of the choroid plexus.
5. Midbrain and posterior thalami - Penetrating PCA branches are the major vascular supply.

Vascular Territory of Vertebrobasilar System

The vertebrobasilar system consists of the two vertebral arteries (VAs), the basilar artery (BA), and their branches.
Vascular territories:

1. Posterior fossa structures.
2. Midbrain.
3. Posterior thalami.
4. Occipital lobes.
5. Most of the inferior and posterolateral surfaces of the temporal lobe.
6. Upper cervical spinal cord.

There is a lack of studies to determine aetiopathogenesis and outcome in PCS, especially in comparison to anterior circulation strokes (ACS). Following Kubik and Adams' original study in 1946, PC strokes have traditionally been considered to have high attendant morbidity and mortality.[9] However, with the publication of data from the New England Medical Center-Posterior circulation stroke registry (NEMC-PCRS), the risk factors and outcome in PCS have been better delineated.[10]

Objectives

We wanted to delineate the pattern of anatomical involvement in PCS stroke by means of CT, MRI, nature of stroke and aetiology in a group of 50 random patients with posterior circulation stroke at a tertiary care hospital.

METHODS

This is an analytical type of observational study. The study was carried out in the Department of Radio-Diagnosis collaborating with the Department of Neuromedicine and General Medicine in Burdwan Medical College & Hospital in 12 months. We studied 50 cases of adult patients of 40-80 yr. age group who presented with posterior circulation stroke. The patients were evaluated clinically and radiologically by means of CT scan and MRI of brain. Socio-demographic data was obtained by means of personal interview.

Sampling Technique

Patients admitted with features of posterior circulation stroke are subjected to clinical evaluation for determination of site, type and aetiology of posterior circulation stroke. Subsequently NCCT was performed in all subjects on CT Scan machine (Sceneria 128, Hitachi) and MRI was performed by GE 1.5T MRI machine. Consent is obtained from the party before including the patient in the study. The findings of the brain MRI are compared with that of clinical evaluation.

Inclusion Criteria

1. Patients experiencing posterior circulation stroke.
2. Age group 40 to 80 yr.

Exclusion Criteria

1. Age group below 40 yr.
2. Patients having infarction with haemorrhagic transformation.
3. Nonconsenting patients.
4. Non-cooperative patients.

Statistical Analysis

On the basis of these clinical, laboratory and radiological data, the PCS is characterized by nature, anatomic location and aetiology. Their characteristic features as obtained in the study were discussed. The data of PCS were compared to the data obtained in previous studies.

RESULTS

We studied 50 cases of adult patients of 40 - 80 yrs. age group who presented with symptoms of posterior circulation stroke.

	Cerebellum	Isolated Brainstem	Isolated Thalamus	Cerebral Lobes	Combined Involvement	Total
Haemorrhagic	4	9	1	0	2	16
Ischaemic	14	13	2	4	1	34
Total	**18 (36%)**	**22 (44%)**	**3 (6%)**	**4 (8%)**	**3 (6%)**	**50**

Table 1. Gross Anatomic Distribution of Posterior Circulation Stroke. (n=50)

	Ischaemic (%) (n=14)	Haemorrhagic (%) (n=4)	Total
RSC	2 (14.29)	0 (0)	2
RIC	4 (28.57)	1 (25%)	5
LSC	3 (21.43)	1 (25%)	4
LIC	5 (35.71)	2 (50%)	7
Total	**14 (100)**	**4 (100%)**	**18**

Table 2. Lobe Wise and Nature Wise Distribution of Cerebellar Strokes

(RCS - Right Superior Cerebellum, RIC - Right Inferior Cerebellum, LSC - Left Superior Cerebellum, LIC - Left Superior Cerebellum)

	RLM	RMM	LMM	LLM
Haemorrhagic	0	2	0	0
Ischaemic	2	0	1	4
Total	**2**	**2**	**1**	**4**

Table 3. Sidewise, Location Wise and Nature Wise Distribution of Medullary Strokes (n=9)

(RLM - Right Lateral Midbrain, RMM - Right Medial Midbrain, LMM - Left Medial Midbrain, LLM - Left Lateral Midbrain)

	Mid Brain			Pons		Thalamus		
	Medial (n=6)	Lateral (n=6)	Superior (n=5)	Mid (n=2)	Inferior (n=4)	Right (n=3)	Left (n=1)	Both (n=2)
Haemorrhagic	3 (50%)	3 (50%)	4 (80%)	2 (100%)	2 (50%)	2 (66%)	1 (100%)	0 (0%)
Ischaemic	3 (50%)	3 (50%)	1 (20%)	0 (0%)	2 (50%)	1 (33%)	0	2 (100%)
Total	**6**	**6**	**5**	**2**	**4**	**3**	**1**	**2**

Table 4. Location Wise and Nature Wise Distribution of Midbrain Strokes (n=12), Pontine Strokes (n=11) and Thalamic Strokes (n=6)

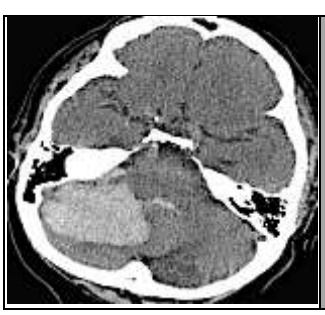

Figure 1. Axial NCCT Image of Brain Showing Hyperdensity (Attenuation of Blood) in Right Cerebellar Hemisphere Extending into 4th Ventricle - Suggestive of Cerebellar Haemorrhage

Figure 2. Axial(a) and Sagittal (b) NCCT Image of Brain Showing Hyperdensity in Pons with Attenuation of Blood, Suggestive of Pontine Haemorrhage

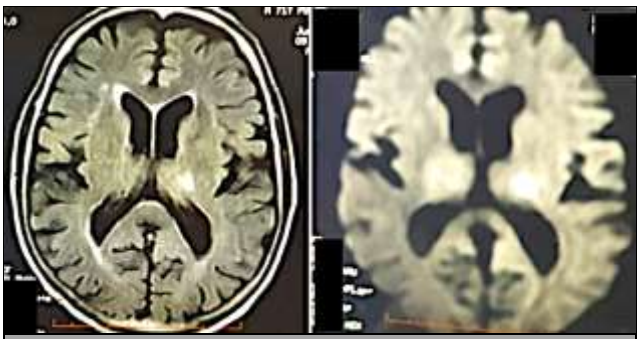

Figure 3. Axial FLAIR Image of MRI Brain Showing Hyperintensity in left Thalamus Which on DWI Shows Restriction Suggestive of Acute Infarction

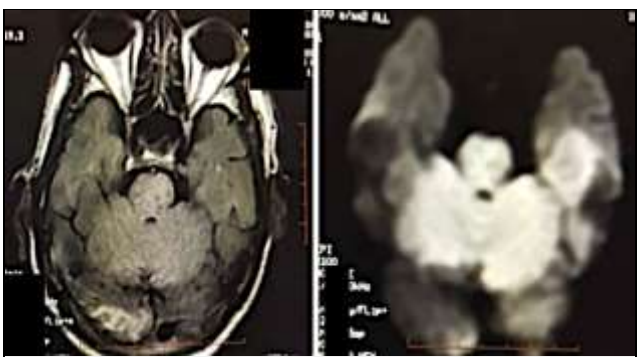

Figure 4. Axial FLAIR Image of MRI Brain Showing Hyperintensity in Pons and Cerebellum Which on DWI Showing Restriction Suggestive of Acute Infarction

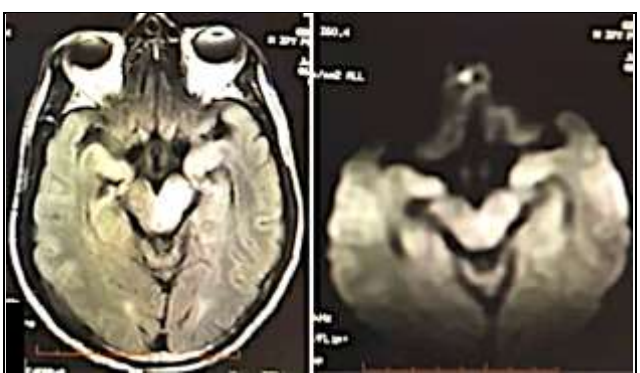

Figure 5. Axial FLAIR Image of MRI of Brain Showing Hyperintensity in left Side of Midbrain Which on DWI Shows Restriction Suggestive of Acute Infarction

Maximum number of patients (21) were in the age bracket of 61-70 yr. (42%) whereas minimum was in the age bracket of 71-80 yr. (2%). Lowest age of patient suffered from posterior circulation stroke was 46 yr. and highest was 75 yr. Mean age was 59.04 +/- 7.05 yrs. Out of 50 patients, 34 had infarction (68%) and rest had haemorrhage. Four patients have cerebral lobar involvement in posterior circulation stroke, all were ischaemic in nature, of which 25% involved inferior temporal lobe and 7% involved parieto-occipital lobe.

Most common risk factor of cerebellar infarction was hypertension followed by smoking, dyslipidaemia and diabetes. Most common risk factor of cerebellar haemorrhage was hypertension followed by diabetes, smoking and dyslipidaemia. Most common risk factor of brainstem haemorrhage was hypertension followed by smoking, dyslipidaemia and diabetes. Most common risk

factor of brainstem infarction was hypertension followed by diabetes, dyslipidaemia and smoking. Most of the hypertensive patients had isolated brainstem involvement (42%) followed by cerebellar involvement (35%). In diabetic patients, most common involvement was isolated brainstem involvement (48%) followed by cerebellar involvement (24%). Isolated brainstem involvement (50%) was most common in dyslipidaemia patients followed by cerebellar involvement (30%). Isolated brainstem (42%) was most commonly involved in smokers followed by cerebellar involvement (33%).

DISCUSSION

Posterior circulation stroke is different from anterior circulation stroke. In Trial of ORG 10172 in Acute Stroke Treatment (TOAST) 1039 patients with AC stroke and 180 patients with PC stroke were studied. [11] There were fewer women in the PC than in the AC groups, but otherwise there were no differences in demographics. Headache and vomiting were more common among PC patients.

Out of 50 cases of posterior circulation stroke, 29 were male (58%) and 21 were female (42%). Mean age was 59.04 +/- 7.05 yr. Male predominance was also noted in the Study by Manmohan Mehndiratta, Sanjay Pandey, Rajeev Nayak et al and the mean age was 51.7 +/- 14.4 yrs.[3] Reason for lower mean age in the reference study may be due to large age bracket (0 - 80 yrs.) as compared to small age bracket (40 - 80 yrs.) in our study. However, the reference study was solely on ischaemic stroke.

34 out of the study population had ischaemic (68%) stroke and rest had haemorrhagic stroke. Study conducted by Uma Sundar, R Mehetre among on Indian population in the year 2005 showed among seventy-six cases of PCS, 77.6% of PCS strokes were ischaemic in origin.[1] Isolated brainstem was involved in maximum number of patients (22 patients; 44%) followed by cerebellum (18 patients; 36%). Least involvement was in case of isolated thalamus as well as combined involvement (3 patients: 6% in each). Study conducted by Uma Sundar, R Mehetre also showed structures most affected are the brainstem and cerebellum.[1]

Out of 18 patients in whom cerebellum were involved, 11 showed involvement of left cerebellar hemisphere (61%), whereas 7 showed involvement of right cerebellar hemisphere (39%). Out of 18 patients who experienced cerebellar stroke, 14 were ischaemic (78%) in nature and 4 were haemorrhagic (22%) in nature.

Two cases of cerebellar stroke who involved right superior cerebellum were ischaemic in nature. Four out of five cases of right inferior cerebellar strokes were ischaemic in nature and rest was haemorrhagic in nature. Three out of four cases of left superior cerebellar strokes were ischaemic, and rest was haemorrhagic. Five out of seven cases of left inferior cerebellar strokes were ischaemic, and rest were haemorrhagic. Among ischaemic stokes in cerebellar hemisphere, left inferior cerebellum was most commonly involved (five cases; 35.71%) followed by right inferior cerebellum (four cases; 28.57%) and right superior cerebellum was least commonly affected (two cases; 14.29%). Among haemorrhagic strokes in cerebellar hemispheres, left inferior cerebellum was most involved (two cases: 50%).

Out of nine patients who experienced medullary strokes, seven were ischaemic (78%); whereas two were haemorrhagic (22%). Out of nine stroke patients in whom medulla was involved, five had involvement of left side of medulla (all ischaemic) and four had involvement of right side of medulla (two ischaemic and two haemorrhagic). Out of nine patients in whom medulla was involved, three (33.33%) had medial medullary stroke and six (66.67%) had lateral medullary strokes. 66.67% of strokes where medial medulla was involved was haemorrhagic in nature. 100% of strokes where lateral medulla was involved was ischaemic in nature. Right lateral medulla was involved in two patients (both ischaemic), right medial medulla was involved in two patients (both haemorrhagic), left medial medulla was involved in one patient (ischaemic) and left lateral medulla was involved in four patients (all ischaemic) among nine patients in whom medulla was involved.

Out of 11 patients in whom pons was involved, three patients (27.27%) had ischaemic stroke, whereas eight (72.73%) had haemorrhagic stroke. Superior pons was involved in five patients [(four haemorrhagic (80%), one ischaemic (20%)], mid/central pons was involved in two patients (both haemorrhagic – 100%) and inferior pons was involved in four patients [two haemorrhagic (50%), two ischaemic (50%)]. Out of 11 cases where midbrain was involved, seven were haemorrhagic (63.64%), four were ischaemic (36.36%) and medial and lateral halves of midbrain involved equally. Among the cases with medial half of midbrain involvement, 50% were haemorrhagic and 50% were ischaemic. Among the cases with lateral half of midbrain involvement, 66.67% were haemorrhagic and 33.33% were ischaemic.

Among 11 patients in whom midbrain was involved, right half of midbrain was involved in three patients (27.27%) [(two were haemorrhagic (66.67%), one was ischaemic (33.33%)], left half was involved in seven cases (63.64%) [five haemorrhagic (71.43%), two ischaemic (28.57%)] and bilateral involvement in one (9.09%) (ischaemic). Out of six patients in whom thalamus was involved three were haemorrhagic (50%) and three were ischaemic (50%). Among six stroke patients, right thalamus was involved in three patients (50%) [two haemorrhagic (66.67%), one ischaemic (33.33%)], left thalamus was involved in one patient (16.67%) (haemorrhagic) and both thalami were involved in two patients (33.33%) (both ischaemic). Among six stroke patients with thalamic involvement, isolated thalamus was involved in three patients (50%) [one haemorrhagic (33.33%), two ischaemic (66.67%)] whereas thalamus with midbrain involvement was in three patients (50%) [two haemorrhagic (66.67%), one ischaemic (33.33%)].

Most common risk factor of cerebellar infarction was hypertension followed by smoking, dyslipidaemia and diabetes. Most common risk factor of cerebellar haemorrhage was hypertension followed by diabetes, smoking and dyslipidaemia. Most common risk factor of

brainstem haemorrhage was hypertension followed by smoking, dyslipidaemia and diabetes. Most common risk factor of brainstem infarction was hypertension followed by diabetes, dyslpidemia and smoking.

So, most common risk factor for posterior circulation stroke was hypertension, which is corroborative with the study by Manmohan Mehndiratta, Sanjay Pandey, Rajeev Nayak et. al although this study was solely on posterior circulation ischaemic stroke.[12] Our study included both ischaemic and haemorrhagic strokes in posterior circulation.

Most common risk factor of cerebellar infarction was hypertension followed by smoking, dyslipidaemia and diabetes. This finding is supported by reference study by Carlos S. Kase, MD; Bo Norrving, MD; Steven R. Levine, MD; et. al which also showed that hypertension was most common risk factor for cerebellar infarction.[13]

Most common signs, symptoms in posterior circulation stroke was bulbar symptoms followed by cerebellar symptoms, long tract signs (sensory, motor) and least common was lobar symptoms. However, in study by Manmohan Mehndiratta, Sanjay Pandey, Rajeev Nayak et al, most common clinical characteristic was cerebellar symptoms followed by motor long tract sign, RICT features, bulbar symptoms and visual symptoms.[12] This discordance may be due to a greater number of brainstem stroke patients in our study where bulbar symptoms predominated.

CONCLUSIONS

Posterior circulation stroke is more common in males in 61 - 70 yrs. age group. In posterior circulation stroke, ischaemic stroke is more common, with isolated brainstem being the most common site and least common site being isolated thalamus / combined involvement. Bulbar symptoms were most common followed by cerebellar symptoms, and long tract signs (sensory, motor); and least common were lobar symptoms. Hypertension is the most common risk factor for posterior circulation stroke, both ischaemic and haemorrhagic.

So, radiological imaging by NCCT Scan of brain and MRI of brain play an important role in delineating the pattern of anatomical involvement in PCS stroke and understand the nature of strokes and aetiologies.

Financial or Other Competing Interests: None.

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