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Original Research Article

A Cross Sectional Study on the Severity of Ataxia in Posterior Circulation Stroke Patients at a Tertiary Care Center

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Abstract:

Background: Posterior circulation strokes account for a significant proportion of all strokes and present with a variety of clinical manifestations, including ataxia. Accurate quantification of ataxia severity can aid in understanding the impact of different posterior circulation stroke patterns.

Objective: This study aims to quantify the severity of ataxias in patients with posterior circulation strokes and identify risk factors associated with specific stroke patterns using MRI.

Methods: We conducted a cross-sectional observational study involving 115 patients with MRI-proven posterior circulation ischemic strokes. All patients had symptom onset within 7 days. The severity of ataxias was assessed using the International Cooperative Ataxia Rating Scale (ICARS). Stroke patterns were categorized based on MRI findings into various territorial patterns, including PICA-CH, SCA-CH, CH/CP, and peduncular patterns.

Results: The study population had a mean age of 57.3 ± 6.6 years, with hypertension (94.7%) being the most prevalent risk factor. Gait ataxia was present in all patients, while limb ataxia, dysarthria, and nystagmus were observed in 81.7%, 46.08%, and 60.8% of patients, respectively. The PICA-CH pattern was identified in 27% of cases, CH/CP in 23.5%, and SCA-CH in 14.8%. Severity of ataxias varied significantly across stroke patterns. The highest mean ICARS scores were observed in the SCA-CH pattern, while the lowest were in the PICA-CH pattern. Hypertension was significantly associated with increased severity of ataxias.

Conclusion: The severity of ataxias in posterior circulation strokes varies according to the involved territory. SCA-CH strokes are associated with the highest severity, while PICA-CH strokes show the least severity. Hypertension is a major risk factor influencing the severity of ataxias. These findings highlight the importance of targeted management and rehabilitation strategies based on stroke patterns and associated risk factors.

Keywords: Posterior circulation stroke, ataxia, International Cooperative Ataxia Rating Scale (ICARS), MRI, stroke patterns, risk factors.

Introduction

Stroke is the third most common cause of death worldwide which is preceded only by coronary heart disease and malignancy [1]. 15-20% of blood flow to the brain is directed to posterior circulation which is responsible for 15-20% of rate of occurrence of posterior circulation strokes in various case series. Incidence of posterior circulation stroke is 6.3 to 13.2 per 100,000 population [2]. 9.2% of ischemic strokes are posterior circulation stroke in India [3]. MRI allows accurate localization of cerebellar and brainstem infarcts [4]. Common clinical manifestations encountered in posterior circulation strokes are gait ataxia, limb ataxia, horizontal nystagmus, dysarthria, headache and vertigo. Risk factors implicated in posterior circulation strokes were hypertension, diabetes mellitus, hyperlipidemia, smoking and coronary artery disease [5]. Cerebellar and brainstem infarcts in different territories produce different clinical manifestations and their severity varies with different location of lesion [6]. There are several scales for quantification of severity of ataxias in various conditions. International Cooperative Ataxia Rating Scale (ICARS) has been used to quantify the severity of ataxias in degenerative conditions such as Friedrich Ataxia, Spinocerebellar ataxia, multisystem atrophy, ataxia with coQ10 deficiency and degenerative ataxia syndromes [7]. Beate Schoch et al studied the reliability and validity of ICARS in lesions other than degenerative lesions such as ischemic lesions and found it to be useful and valid in degenerative as well as focal cerebellar lesions [8]. Studies on quantification of severity of ataxias in different brainstem and cerebellar infarcts of posterior circulation strokes are limited. This study focuses on quantifying severity of ataxias in different types of posterior circulation strokes categorized by territory involved using MRI and to identify any particular risk factor associated with specific territory involved.

Materials and Methods

Study population: All patients with posterior circulation stroke attending neurology department in Tirunelveli medical college.

Study design: cross-sectional observational study.

Study duration and size: Consecutive patients with posterior circulation stroke between july2023 to june2024.

Inclusion Criteria

All patients with MRI proven posterior circulation ischemic stroke between july2023 to june2024 with symptom onset <7 days involving cerebellum and/or cerebellar peduncles in the brainstem were taken into study.

Exclusion Criteria

1. Patients with previous history of ischemic stroke with residual weakness, sensory impairments or ataxia.
2. Inability to undergo MRI due to insitu pacemaker.
3. Hemodynamically unstable and patients with poor GCS in whom severity of ataxias cannot be measured were excluded.
4. Patients with acute ischemic stroke in other areas in addition to above mentioned sites and hemorrhagic stroke were excluded.
5. Patients with coexisting ataxia of other causes were excluded.

Methodology

All consecutive patients who were diagnosed with posterior circulation stroke based on MRI findings and with presence of ataxia were taken into the study between july2023 to June 2024. Written consent was obtained from all the patients. Basic characteristics such as age, sex and risk factor profile such as smoking, alcohol consumption, diabetes, hypertension, coronary artery disease and dyslipidemia were described.

Patient is then examined clinically and severity of ataxia is quantified using International Cooperative Ataxia Rating Scale (ICARS). ICARS has maximum score of 100 and it evaluates limb ataxia (max score 52), gait ataxia (max score 34), dysarthria (max score 8) and oculomotor abnormalities (max score 6). Based on MRI findings in posterior circulation stroke, following topographical patterns were identified: picaCH pattern – cerebellar hemispheric infarct in the PICA territory

A. PicaCH-P- sub pattern of picaCH in which entire pica territory is involved
B. PicaCH-bz – sub pattern of picaCH in which only border zone territory between medial and lateral pica branches is involved
C. SCA CH pattern- cerebellar hemisphere infarct in superior cerebellar artery territory
D. CH/CP pattern- lesion involving both cerebellar hemispheres and cerebellar pathways in brainstem.
E. I-ped- involvement of inferior cerebellar peduncle in medulla.
F. M-ped- involvement of middle cerebellar peduncle in the pons.
G. S-ped- involvement of superior cerebellar peduncle in the midbrain and/or posterolateral thalamus.

Basic characteristics, risk factor profile, Severity (using ICARS), frequency and type of ataxias are correlated with territory involved using MRI brain.

Statistical analyses

Categorical variables were compared using the chi-square test. Non- parametric Kruskal-Wallis analysis of variance (ANOVA), the Wilcoxon-Mann-Whitney and spearman rank correlation test were used as ICARS numerical variables are ordinal data. For continuous numerical variables with a normal distribution, t-test was used. Multiple linear regression analysis for numerical variables was performed. Statistical significance was set at $p<0.05$. Statistical analyses were performed using SPSS software.

Results

Basic characteristics

Total of 115 patients were taken into study of which 64(55.7%) were females and 51(44.3%) were males. Mean [SD] age was 57.3 ± 6.6. Among the risk factor profile diabetes was seen in 40% of the patients and hypertension in 94.7% of patients and history of coronary artery disease in 6.9% (8) of patients. 38.3% of them were smokers and 39.1% of them were alcoholic. Lipid profile done in these patients in which 68.7%(79) of patients had low HDL levels <35mg/dl , high triglyceride levels were seen in 36.5%(42) of patients , high total cholesterol in 33.9%(39) of patients and LDL in 33%(38) of patients. Among them low HDL levels and hypertension have found to be the major risk factors which were statistically significant. Only one patient with posterior circulation stroke arrived at hospital within 4.5 hours of symptom onset and was not thrombolysed as patient had recent MI. 51.3%(59) of patients reached hospital by 4.5-12 hours, 20.9%(24) of patients by 12-24 hours and 27%(31) of patients arrived at hospital greater than 24 hours.

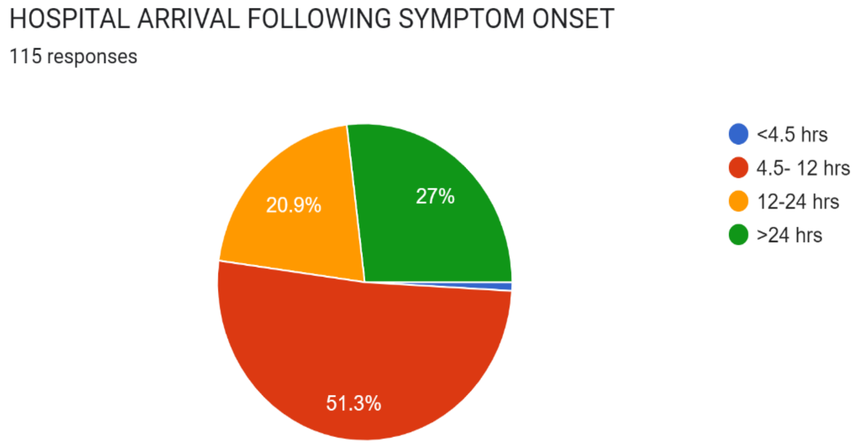

Figure 1: Hospital arrival following symptom onset

Types of ataxias

Gait ataxia seen in 100% (115) of patients, limb ataxia in 81.7%(94) of patients, dysarthria in 46.08% (53) and nystagmus in 60.8%(70) of patients.

Territory involved

Among the territories involved in posterior circulation stroke, PICA-CH pattern is seen in 27% (31) of patients, CH/CP pattern in 23.5% (27) of patients, i-ped pattern in 14.8%(17) of patients, mcp pattern in 12.2%(14) of patients, s-ped pattern in 9.6%(11) of patients and PICA CH-bz pattern in 5.2% (6) of patients.

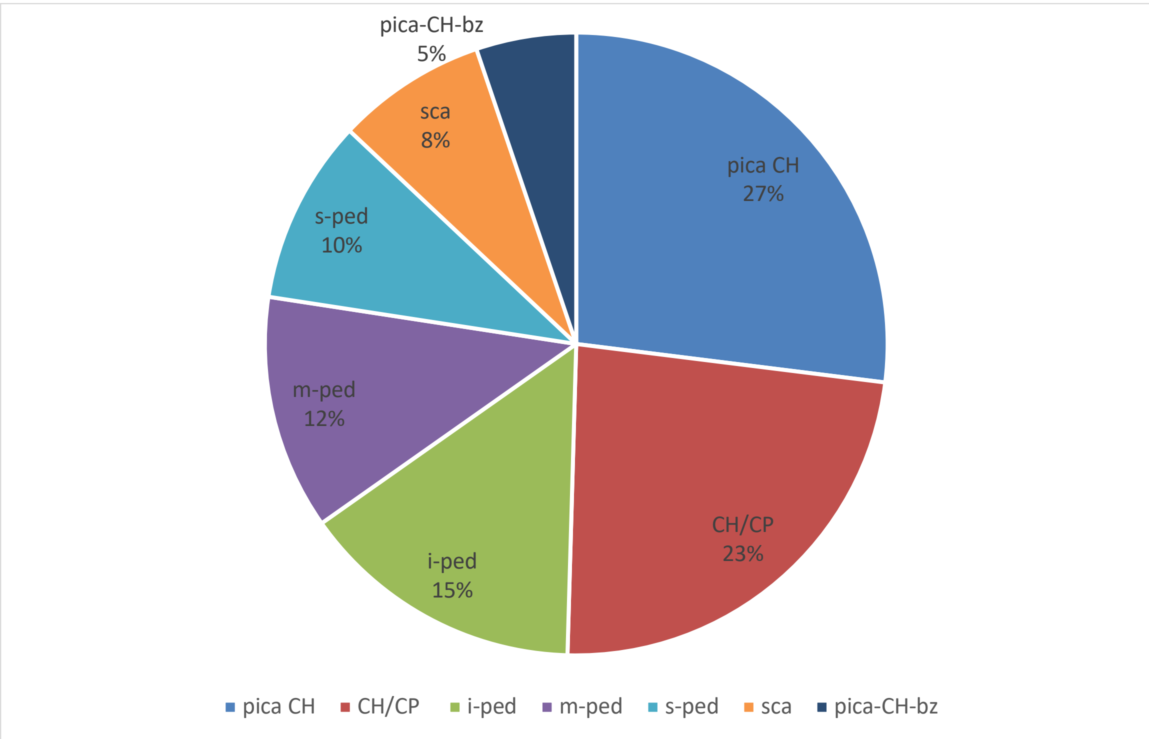

Figure 2:

Frequency of ataxia

Frequency of gait ataxia is similar among different territories involved. Limb ataxia is found in all patients with PICA-CH/CP, sca and s-ped pattern. Frequency of limb ataxia is very low in PICA CH pattern compared to other groups and were statistically significant with p value of <0.0001. Dysarthria is seen in 88% of patients with sca territory infarct. Frequency of dysarthria is low with pica-CH pattern with statistically significant difference with other groups p =0.0003.

Though frequency of nystagmus is higher with pica CH/CP pattern it was not statistically significant (p=0.175) compared with other groups.

Table 1:

	PicaCH	PicaCH-bz	CH/CP	SCA	i-ped	m-ped	s-ped
LIMB ATAXIA	13(42%)	5(83.3%)	27(100%)	9(100%)	16(94.1%)	13(92.9%)	11(100%)
GAIT ATAXIA	31(100%)	6(100%)	27(100%)	9(100%)	17(100%)	14(100%)	10(90.9%)
DYSARTHRIA	6(19.4%)	0	19(70.37%)	8(88.9%)	10(58.8%)	7(50%)	4(36.4%)
NYSTAGMUS	15(48.4%)	4(66.7%)	22(81.5%)	8(88.9%)	9(53%)	7(50%)	5(45.5%)

Mean score for severity of ataxia is highest with PICA-CH/CP pattern (45.74), but the severity of ataxia with regard to total ataxia score is not statistically significant when compared with SCA group (mean- 38.56, p -0.051) and other groups.

Mean score for severity of ataxia is lowest with PICA-CH pattern with mean of 16.4 and there is significant difference in severity when compared with m-ped group (mean – 21.86, p – 0.046), PICA CH-bz group (mean 23.17, p – 0.04) and other groups.

Severity of gait ataxia

Mean score for severity of gait ataxia is highest with SCA pattern (mean – 24), comparing with other groups there is no significant difference when compared with CH/CP group- (mean- 23.4, p – 0.82), but severity of SCA pattern is high when compared with i-ped group (mean- 16.9, p-0.0007), PICA-CH bz group (p-0.001, mean-11.83), s-ped (mean – 10.5, p- 0.0001), m-ped (p-0.00008, mean- 11.86), PICA-CH pattern (p-0.000005). Mean score for severity of gait ataxia is lowest with scp pattern (mean – 10.5). when compared with other groups PICA CH (p- 0.052- not significant), PICA CH/CP (p- 0.000005, significant), PICA CH-bz (p- 0.54 , not significant), SCA (p-0.0001, significant), mcp (p- 0.26, not significant), i-ped (p- 0.00035, significant).

Severity of limb ataxia

Mean score for severity of limb ataxia is 10.47. Mean score for severity of limb ataxia is highest for PICA- CH/CP pattern (18.37). Comparing with other groups there is statistically significant difference with PICA-CH group (p- <0.00001, mean-3.94), PICA-CH bz (p-0.0006), SCA (p-0.000009, mean – 8.78), scp (p- 0.054 , not significant), i-ped(p-<0.00001, mean-8.64), mcp (p- <0.0001, mean-8.5),

Mean Severity of limb ataxia is lowest with PICA-CH pattern (mean- 3.94) and is significantly lower when compared with PICA- CH/CP (P- <0.0001 , mean- 18.37), PICA-CHbz (p- 0.015, not significant), SCA (p – 0.007, mean-8.78), scp (p-0.00002), mcp (p- 0.25, not significant), i-ped (p-0.002, significant).

Severity of dysarthria

Mean severity- 1.16

Mean score for severity is highest with SCA pattern (mean – 4.22) and is statistically significant when compared with PICA- CH (p – 0.000004), PICA-CH bz(p-0.003), PICA-CH/CP- (P- 0.001), scp (p-0.001), mcp (p- 0.001), i-ped (p-0.0005). Dysarthria was not seen in PICA-CH bz pattern.

Severity of nystagmus and oculomotor abnormalities

Mean score- 1.04

Severity is highest with PICA-CH/CP pattern – mean- 1.96 and statistically significant when compared with PICA-CH bz (p-0.03), sca (p-0.03), scp- (p-0.001), PICA- CH (p- 0.0002), mcp (p-0.0009), Not significant with i-ped (p- 0.02, mean-1.12). Severity is lowest with scp (mean -0.45) and not significant with iped (p- 0.22), significant with PICA-CH/CP (p- 0.001), not significant with PICA CH (p- 0.70), not significant with mcp (p-1), not significant with PICA-CH bz (p-0.64), not significant with SCA (p-0.053).

Table 2:

Ataxic signs	PicaCH	picaCH-bz	CH/CP	SCA	i-ped	m-ped	s-ped
gait ataxia mean[SD]	12.7 [2.1]	11.8 [1.9]	23.4 [4.7]	24 [2.6]	16.9 [3.8]	11.9 [1.5]	10.5 [4]
limb ataxia mean[SD]	3.9 [5.4]	10.7 [5.8]	18.4 [4.6]	8.8 [1.5]	8.6 [3.8]	8.5 [3.1]	16 [6.4]
Dysarthria Mean[SD]	0.2 [0.8]	0	1.8 [1.5]	4.2 [1.9]	1 [0.9]	1 [1]	0.7 [1]
Oculomotor abnormalities Mean[SD]	0.7 [0.4]	0.7 [0.5]	1.9 [1.3]	0.9 [0.3]	1.12 [1.1]	0.5 [0.5]	0.5 [0.5]

Discussion

This study aimed to quantify the severity of ataxias in various types of posterior circulation strokes and to elucidate the relationship between infarct territories and clinical manifestations. The findings contribute valuable insights into how different stroke patterns in the posterior circulation impact the severity and types of ataxias experienced by patients.

Infarct Patterns and Clinical Manifestations

Our study observed that gait ataxia was present in all patients with posterior circulation strokes, confirming its prevalence across different infarct patterns. This finding is consistent with existing literature that underscores gait ataxia as a hallmark of cerebellar and brainstem involvement.

However, the study revealed variability in the severity of ataxia based on the infarct's location. The PICA-CH/CP pattern demonstrated the highest mean severity of ataxia, although this was not significantly different from the SCA group. This suggests that while certain infarct patterns may be associated with more severe ataxias, the clinical presentation can be influenced by multiple factors, including the extent and exact location of the infarct.

Specific Patterns and Severity of Ataxias

The results highlight distinct differences in the severity of limb ataxia and dysarthria among various infarct patterns. For instance, the PICA-CH and PICA-CH-bz patterns exhibited significantly lower severity of limb ataxia compared to other groups. This finding aligns with previous studies that indicate the cerebellar hemispheric involvement in the PICA territory may not always produce as severe limb ataxia as seen with other infarct patterns. On the other hand, the SCA pattern was associated with the highest severity of dysarthria, which could be attributed to the involvement of structures crucial for speech production.

The CH/CP pattern was associated with significant severity in multiple ataxic symptoms, suggesting that involvement of both cerebellar hemispheres and pathways in the brainstem can result in more complex and severe clinical presentations. This pattern may lead to a broader disruption of neural circuits involved in motor control, contributing to the observed severity of symptoms.

Risk Factors

Our study corroborates previous findings regarding the role of hypertension and low HDL levels as significant risk factors in posterior circulation strokes. The high prevalence of hypertension among our cohort (94.7%) reflects its well-established association with stroke risk and severity. Low HDL levels, found in a substantial proportion of patients, also underline the importance of lipid management in stroke prevention.

Timing of Hospital Arrival

The timing of hospital arrival, with a significant proportion of patients arriving more than 12 hours after symptom onset, underscores a critical gap in timely intervention. The delay in treatment is a major concern, as early thrombolysis or other therapeutic interventions can significantly impact outcomes in stroke patients. The single patient who arrived within 4.5 hours but was not thrombolysed due to recent MI further emphasizes the complexity of acute stroke management and the need for tailored treatment protocols.

Limitations and Future Directions

While this study provides a detailed analysis of ataxias in posterior circulation strokes, it is not without limitations. The cross-sectional nature of the study limits our ability to draw conclusions about the progression of ataxias over time. Additionally, the study's reliance on MRI and ICARS scores may not fully capture the nuanced effects of stroke on ataxia and functional outcomes.

Future research should aim to include longitudinal studies to assess the long-term impact of various infarct patterns on ataxia and overall recovery. Larger sample sizes and multicentric studies could further validate our findings and explore additional factors influencing stroke outcomes.

Conclusion

In conclusion, this study enhances our understanding of the relationship between infarct patterns in posterior circulation strokes and the severity of ataxias. By identifying specific patterns associated with different ataxic symptoms, this research provides a foundation for more targeted therapeutic approaches and underscores the importance of early intervention and comprehensive risk factor management. Continued exploration in this area is essential for improving patient outcomes and advancing stroke care.

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