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Difference of Outcome Between Anterior and Posterior Circulation Ischemic Stroke at Six Months

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Abstract

Background: *Stroke is the leading cause of disability and a major public health issue in worldwide. Outcomes of ischemic stroke are directly related to the location and types of strokes.* ***Aim:*** *To compare outcome of anterior and posterior circulation ischemic stroke at six months.* ***Methodology:*** *A prospective cohort study was carried out in the department of Neurology, Dhaka Medical College hospital from January 2022 to February 2023. A total 200 subjects were included in this study based on inclusion and exclusion criteria Neurological state of the patient was assessed on the 1st day of hospitalization by National institute of Health Stroke Scale (NIHSS) and functional status of the patient were assessed on discharge, 1 month, 3 months and 6 months after onset of stroke by Modified Rankin scale (mRS). A mRS of 3 to 6 was considered as poor outcome and mRS of 0-2 as good outcome.* ***Results:*** *In this study, mRS was d"2 in 59%, 66%, 74% and 79% after anterior circulation stroke and mRS was d"2 in 65%, 70%, 76% and 77% after posterior circulation stroke respectively at discharge, 1month, 3 months and 6 months. It was found improved progressively at different follow-up periods in both groups. So, no significant (p>0.05) difference was observed in mRS score of both groups. In present study, mortality at 6 months after stroke was 7% and 17% in ACS and PCS groups respectively. Statistically significant (p=0.029) difference was observed in mortality of both groups at 6 months follow-up. Binary analysis showed that age (OR:1.48, 95%CI: 1.170 to 1.864), male gender (OR:0.44; 95%CI: 0.188 to 1.032), duration of stroke (OR: 1.69; 95% CI: 1.208 to 2.361), initial NIHSS score (OR:1.35; 95%CI: 1.098 to 1.653) and artery-to-artery embolic occlusion (ATO) (OR:1.36; 95%CI: 1.196 to 1.548) in anterior circulation stroke and duration of stroke (OR: 1.89; 95% CI: 1.185 to 3.013), initial NIHSS score (OR:0.34; 95%CI: 0.255 to 0.470), artery-to-artery embolic occlusion (ATO) (OR:1.72; 95%CI: 1.120 to 2.634), cardioembolic occlusion (CAO) (OR:0.57; 95%CI: 0.448 to 0.722) and intracranial arterial steno-occlusion (ICASO) (OR:1.36; 95%CI: 1.007 to 1.840) in posterior circulation stroke were independently associated (p<0.05) with favorable 6-months mRS scores.* ***Conclusion:*** *It can be concluded that the proportions of favorable outcomes at 1 month, 3 months and 6 months follow-up period were similar between the two groups, whereas 6 months mortality was higher in the posterior circulation stroke group than the anterior circulation stroke group.*

Kew words: *Outcome of stroke, Anterior circulation stroke, Ischemic stroke, posterior circulation stroke.*

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Introduction

Strokes are categorized as either ischemic or hemorrhagic. Ischemic strokes can be further specified according to their vascular territory as anterior circulation stroke (ACS) and posterior circulation ischemic stroke (PCS).[1] ACS are a clinical syndrome caused by ischemia predominantly in both the deep and superficial territories of the internal carotid artery, anterior cerebral artery, anterior communicating artery and middle cerebral artery, resulting in higher cerebral dysfunctions such as dysphasia, dyscalculia, visuospatial disorder, homonymous visual field defect, and ipsilateral motor and/or sensory deficit of at least two areas of the face, arm and leg.[2] Posterior circulation strokes (PCS) are defined by an infarction that is located in the vascular territory supplied by the vertebra basilar arteries. The posterior circulation of the brain consists of the occipital and medial temporal lobes, cerebellum, brain stem and thalamus. PCS is characterized by mild symptoms of transient neurological attacks of nausea, vomiting, dizziness, and vertigo and moderate to severe symptoms of headache, altered consciousness, bulbar signs of slurred speech and dysphagia, weakness, sensory dysesthesia, and ataxia.[3] Outcomes of ischemic stroke are directly related to the location and types of strokes. The reported outcome of the anterior and the posterior circulation ischemic stroke is conflicting and inadequate. Some studies reported the posterior circulation infarcts (PCI) have a poor outcome with high mortality and morbidity and other studies reported poorest outcomes in anterior circulation strokes. But data was not adequate to compare outcome of anterior and posterior circulation ischemic stroke. So, present study has been designed to compare outcome of anterior and posterior circulation ischemic stroke at six months.

Materials and Methods:

Our cohort study was conducted in Department of Neurology, Dhaka Medical College Hospital, Dhaka. Ethical approval was obtained from the DMCH ethical review board prior to the commencement of the study. In all patients, neurological assessment was conducted routinely. Anterior and posterior circulation ischemic stroke were diagnosed on the basis of positive lesions on CT scan of brain and or MRI of brain. Patients with ischemic stroke who exhibited positive lesions on CT scan of brain and or diffusion-weighted imaging (DWI) of brain and who were admitted within 7 days of stroke onset, age >45 years were included and patients with premorbid disability (defined as pre-stroke modified Rankin Scale [mRS] score >1), recurrent stroke were excluded from the study. After selection of the subjects, the nature, purpose and benefit of the study was explained to each subject in details. They were encouraged for voluntary participation. Informed written consent was taken from the participants or legal attendant. The history of previous disease and habits as well as demographic, vascular risk factor, biochemical data and CT findings and or MRI of brain were recorded. Blood pressure was measured. All the information was recorded in a structured data collection sheet. Th-e outcome determinants was mortality and morbidity as measured using the National Institute of Health Stroke Scale (NIHSS) at admission, Glasgow Coma Scale (GCS) and modified Rankin Scale (mRS) at admission, discharge, 1 months, 3 months and 6 months. A mRS of >2 was considered as poor outcome and mRS of d”2 as good outcome. In cases where the patient was failed to visit the hospital, a telephonic mRS was recorded by telephonic interview guide.

Data processing & analysis

All the data were compiled and sorted properly and the numerical data was analyzed statistically by using Statistical Package for Social Scientists (SPSS-26) (IBM Corporation, Armonk, NY). The results were expressed as frequency, percentage, mean ± SD. Mann-Whitney U test, Chi-Square test, Z proportion test and Binary logistic regression analysis were performed as applicable. Survival analysis was done with Kaplan Meier graph and

the log rank test was used to measure the significance, Hazard ratio {95% confident interval (CI)} was calculated and p value <0.05 was considered as the level of significance.

Results:

For this study 100 anterior circulation ischemic stroke and 100 posterior circulation ischemic stroke patients were included. Median age was 64 and 66 years respectively, majority were male, came from rural area (73% & 71%), level of education was secondary and above and variable in their occupations. In this study, median systolic blood pressure was 140 (90-200) mmHg and diastolic blood pressure was 87.5 and 90 (50-110) mmHg. Our study found that majority of the stroke patients were diabetic (47%; 59%), hypertensive (76%; 71%) dyslipidemic (82%;75%) and had history of atrial fibrillation (09%;07%). In present study, only 17% and 23% stroke patients were smoker, length of hospital stay was e"10 days in 63% and 61% cases respectively. No significant difference was observed between the groups.

Cardioembolic factors were found in the majority cases of stroke in both groups (66%; 49% respectively). Majority (39%; 45%) of the stroke patients presented in the hospital within 24 to 48 hours after episodes. At admission, GCS score was 10.1 (4-15) and 10.1 (6-15) and NIHSS score was 15.7 (3-32) and 14.8 (4-25). Our study observed that mRS score was improved progressively in both groups. So, no significant difference was observed in mRS score of both groups. Mortality was significantly (p=0.029) more at 6 months follow-up in PCS (17%) than ACS (7%). Among the mRs score >2, 7 (7%) cases developed death in ACS group and 17 (17%) cases developed death in PCS group. The rate of survival was 93% and 83% in both groups respectively. This difference was statistically significant (p=0.029).

Binary analysis showed that age (OR:1.48, 95%CI: 1.170 to 1.864), male gender (OR:0.44; 95%CI: 0.188 to 1.032), duration of stroke (OR: 1.69; 95% CI: 1.208 to 2.361), initial NIHSS score (OR:1.35; 95%CI: 1.098 to 1.653) and artery-to-artery embolic occlusion (ATO) (OR:1.36; 95%CI: 1.196 to 1.548) in the ACS group were independently associated (p<0.05) with favorable 6-months mRS scores. Binary analysis showed that duration of stroke (OR: 1.89; 95% CI: 1.185 to 3.013), initial NIHSS score (OR:0.34; 95%CI: 0.255 to 0.470), artery-to-artery embolic occlusion (ATO) (OR:1.72; 95%CI: 1.120 to 2.634), cardioembolic occlusion (CAO) (OR:0.57; 95%CI: 0.448 to 0.722) and intracranial arterial steno-occlusion (ICASO) (OR:1.36; 95%CI: 1.007 to 1.840) in the PCS group were independently associated (p<0.05) with favorable 6-months mRS scores. During the course of study, only few patients developed stroke related complication like post stroke epilepsy, post stroke pain, aspiration pneumonia, UTI, pressure sore, electrolyte imbalance, contracture and death.

Table-I

Comparison of mRS score of the study subjects at different follow-up (N=200)

mRS	ACS (n=100)	PCS (n=100)	p value
At discharge			
≤2	59 (59%)	65 (65%)	0.382^{ns}
>2	41 (41%)	35 (35%)	
At 1 month			
≤2	66 (66%)	70(70%)	0.544^{ns}
>2	34(34%)	30(30%)	
At 3 months			
≤2	74(74%)	76(76%)	0.744^{ns}
>2	26(26%)	24 (24%)	
At 6 months			
≤2	79(79%)	77(77%)	0.733^{ns}
>2	21(21%)	23(23%)	

Our study observed that mRS score was improved progressively in both groups and no significant difference was observed in mRS score of both groups. Chi Square test was performed and p <0.05 was accepted as level of significant. ns=not significant. ACS: Anterior Circulation Stroke; PCS: Posterior Circulation Stroke.

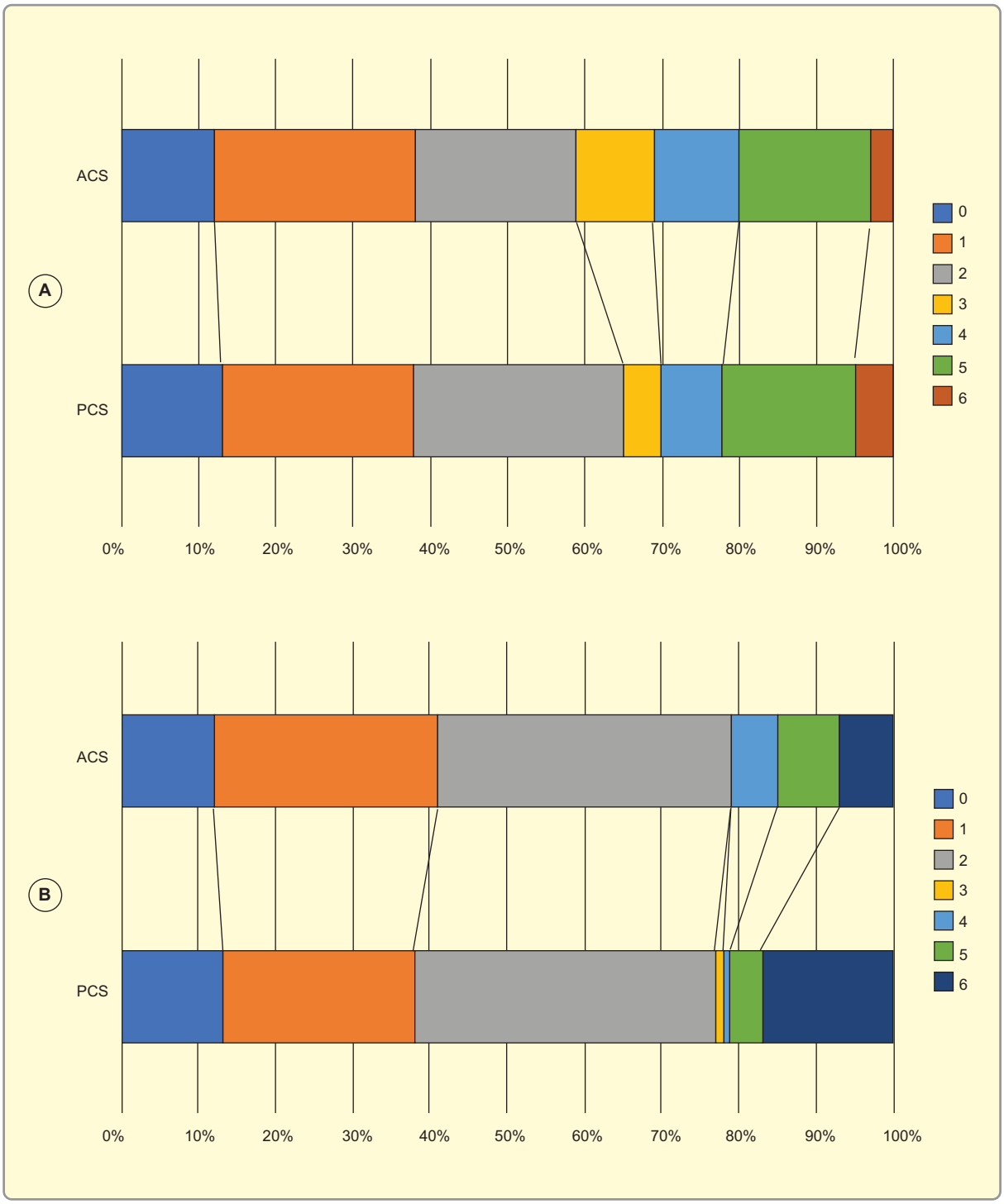


Fig.-1: *Figure showing modified Rankin Scale (mRS) at discharge (A) and 6 months (B) between anterior circulation stroke (ACS) and posterior circulation stroke (PCS) groups (N=200) Numbers in a bar represent the number of patients; ACS, Anterior Circulation Stroke; PCS, Posterior Circulation Stroke.*

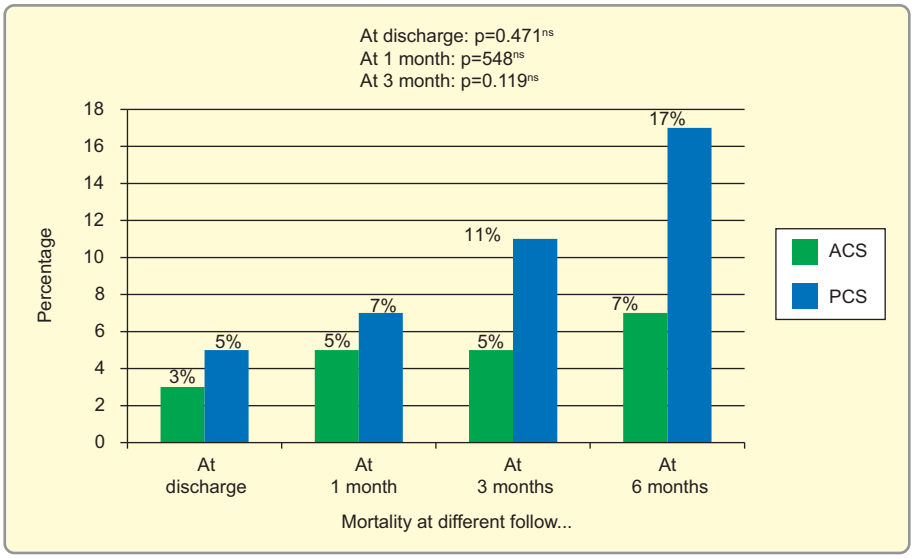
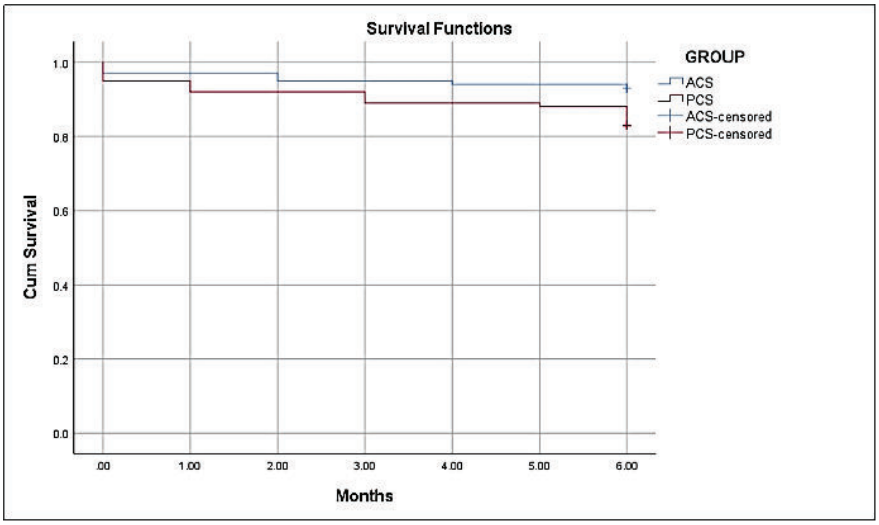


Fig.-2: *Figure showing distribution of the study subjects according to mortality at different follow-up (N=200). Mortality was significantly (p=0.029) more at 6 months follow-up in PCS (17%) than ACS (7%). p value was obtained from Z Proportion test. ACS, Anterior Circulation Stroke; PCS, Posterior Circulation Stroke, ns =not significant.*



Events	Total study subjects (N=200)	ACS (n=100)	PCS (n=100)	HR (95% CI)	p value
Death	24 (12%)	7 (7%)	17 (17%)	5.720 (5.473 to 5.967)	0.029[s]
Survived	176 (88%)	93 (93%)	83 (83%)	5.450 (5.129 to 5.771)	

Fig.-3: *Kaplan–Meier survival curve from discharge to 6 months of study subjects with ACS and PCS (N=200) ACS, Anterior Circulation Stroke; PCS, Posterior Circulation Stroke; HR, Hazard Ratio, s=significant. p value was obtained from Log Rank (Mantel-Cox).*

Discussion:

Among the study subjects, 51% patient was <65 years in anterior circulation stroke group and 53% patients belongs to >65 years of age in posterior circulation stroke group. Median age was 64(45-88) and 66 (46-88) years respectively. Mean age was 62 years in a study conducted by Aldag in 2018.[4] in another study, mean age was found to be 67 years in posterior circulation stroke and 70 years in anterior circulation stroke patients.[5] Above all studies were concurrent with our findings.

In present study, 54% and 51% were male and 46% and 49% patients were female. Male and female ratio was 1:1.2 and 1:1 in both anterior and posterior circulation stroke group. Aldag in 2018 observed around 72% male and 28% female were affected in their study.[4] Another study also informed that male were affected more in both anterior and posterior circulation stroke.[5]

In this study, median systolic blood pressure was 140 (90-200) mmHg and diastolic blood pressure was 87.5 and 90 (50-110) mmHg. Statistically no significant (p>0.05) difference was found in blood pressure of both anterior and posterior circulation stroke patients. A study in 2008 found systolic blood pressure 158 mmHg in overall stroke patients and reported that systolic blood pressure was 1.00 (95% CI: 1.00 to 1.00) times more risk for development of stroke. No study was found to compare diastolic blood pressure may be due to different in methodology.

Our study found that 17% and 23% stroke patients were current smoker. Majority of the stroke patients were diabetic (47%; 59%), hypertensive (76%; 71%) dyslipidemic (82%;75%) and had history of atrial fibrillation (09%;07%). Similar findings were observed by various researchers of different countries.[7,8,9] The most common risk factor was hypertension (69.1%), followed by history of smoking (57%), hyperlipidemia (55.2%), diabetes mellitus (48%). In addition, 20.6% had heart disease and 6.7% atrial fibrillation.[7]

In existing study, causes of stroke were intracranial arterial steno-occlusion (19%;29%), artery-to-artery embolic occlusion (15%; 22%) and cardioembolic occlusion (66%;49%) in both groups. Almost similar observation was observed by Kwon.[9] Regarding the stroke mechanism, cardiac causes less often in posterior circulation strokes.

About 29% and 32% patients came to hospital within 24 hours after onset of stroke. with 39% and 45% patients came to hospital after 24-48 hours onset of stroke. 32% and 23% patients came to hospital after 48-72 hours onset on stroke in both anterior circulation stroke and posterior circulation stroke groups. A study in 2019 demonstrated that despite better known onset times of symptoms, delay to the hospital was longer in posterior circulation strokes but these differences were minor than anterior circulation strokes.[5]

The present study revealed that, GCS score was 10.1 (4-15) and 10.1 (6-15) and NIHSS score was 15.7 (3-32) and 14.8 (4-25) at admission in both groups. Another study in 2019 informed that the severity of posterior circulation strokes, measured by NIHSS was less severe on admission.[5] A study in 2022 revealed NIHSS score was 12 at admission.[10] Another study in 2021 found 11 and 7 during admission in their study.[8] So, our findings were concomitant with above studies. Length of hospital stay was e”10 days in 63% and 61% cases. No study was found to compare our findings due to different in methodology.

In current study, mRS was d”2 in 59%, 66%, 74% and 79%, mRS was >2 in 41%, 34%, 26% and 21% respectively at discharge, 1month, 3 months and 6 months after anterior circulation stroke. It was found improved progressively at different follow-up periods. mRS was d”2 in 65%, 70%, 76% and 77%, mRS was >2 in 35%, 30%, 24% and 23% respectively at discharge, 1month, 3 months and 6 months after posterior circulation stroke. It was found improved progressively at different follow-up periods. So, no significant (p>0.05) difference was observed in mRS score of both groups. Another similar study in Egypt observed that 59% and 70.2% ACS cases and 75% and 93.8% PCS cases had mRS d” 2, while 41% and 29.8% ACS cases and 25% and 6.3% PCS cases had mRS >2 at discharge and 3 months after Stroke.[8] Upon assessing and comparing the mRS on discharge and 180 days, it was found that there was highly significant improvement in both anterior

and posterior group. Our observation also corresponds with that study.[8]

Our study revealed that, mortality at discharge was 3% and 5%, at 1 month after stroke 5% and 7%, at 3 months after stroke 5% and 11% and at 6 months after stroke 7% and 17% in ACS and PCS groups respectively. Statistically significant (p=0.029) difference was observed in mortality of both groups at 6 months follow-up. Kaplan–Meier survival curve from discharge to 6 months is shown that the rate of survival was 93% and 83% in both groups respectively. This difference was statistically significant (p=0.029). Another study evaluated short-term mortality rates at 6 months and revealed that 5% patients with anterior circulation stroke and 9% posterior circulation stroke had died.[10] Rate of survival was 95% in anterior circulation stroke and 91% of posterior circulation stroke.[11] Rate of mortality was 6.6% in anterior circulation stroke and 15.1% in posterior circulation stroke at 3 months after stroke.[10] Their finding was parallel with our findings. But another study disagreed with our study.[8] They detected that only 2.4% mortality after anterior circulation stroke. This dissimilarity may be due to demographic, nutritional and methodological differences.[8] Almost similar study was performed in Switzerland.[5]

Binary analysis showed that age (OR:1.48, 95%CI: 1.170 to 1.864), male gender (OR:0.44; 95%CI: 0.188 to 1.032), duration of stroke (OR: 1.69; 95% CI: 1.208 to 2.361), initial NIHSS score (OR:1.35; 95%CI: 1.098 to 1.653) and artery-to-artery embolic occlusion (ATO) (OR:1.36; 95%CI: 1.196 to 1.548) in anterior circulation stroke and duration of stroke (OR: 1.89; 95% CI: 1.185 to 3.013), initial NIHSS score (OR:0.34; 95%CI: 0.255 to 0.470), artery-to-artery embolic occlusion (ATO) (OR:1.72; 95%CI: 1.120 to 2.634), cardioembolic occlusion (CAO) (OR:0.57; 95%CI: 0.448 to 0.722) and intracranial arterial steno-occlusion (ICASO) (OR:1.36; 95%CI: 1.007 to 1.840) in posterior circulation stroke were independently associated ($p<0.05$) with favorable 6-months mRS scores. A study in Korea observed that age (OR:0.97; 95%CI: 0.95 to 0.99), baseline NIHSS score (OR: 0.86; 95% CI: 0.81 to 0.91) and artery-to-artery embolic occlusion (ATO) (OR:1.65; 95%CI: 0.95 to 2.86) in anterior circulation stroke and age (OR: 0.95 95% 0.91–0.99), baseline NIHSS score (OR: 0.84; 95% CI:0.75 to 0.93) and duration of stroke (OR: 1.00; 95%CI: 1.00–1.001) in posterior circulation stroke were independently associated with favorable mRS scores.[9] During the course of study, only few patients developed stroke related complication like post stroke epilepsy, post stroke pain, aspiration pneumonia, urinary tract infection, pressure sore, electrolyte imbalance, contracture and death. Post stroke pain, contracture, post stroke epilepsy, electrolyte imbalance were more in anterior circulation ischemic stroke than posterior circulation ischemic stroke while aspiration pneumonia, pressure sore were more in posterior circulation ischemic stroke than anterior circulation ischemic stroke.

Conclusion:

The proportions of favorable outcomes at 1 month, 3 months and 6 months follow-up period were similar between the two groups. But 6 months mortality was higher in the posterior circulation stroke group than the anterior circulation stroke group. It is evident that age<65 years, male gender, lower baseline NIHSS score, artery-to-artery embolic occlusion in anterior circulation stroke, shorter duration of stroke, lower baseline NIHSS score, regardless of etiology in posterior circulation stroke were independently associated with favorable outcome.

Limitation

As the study was conducted in a single hospital; the study population might not represent the whole community. The sample was taken purposively. So, there may be chance of bias which could have influenced the results. The study and follow-up period were short in comparison to other studies.

Recommendation

Population based study can be done with large sample size. Study may be longer period. So that we find out the long-term outcome.

Conflict of interest: None Declared

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References:

1. Handelsmann H, Herzog L, Kulcsar Z, Luft AR, Wegener S. Predictors for affected stroke territory and outcome of acute stroke treatments are different for posterior versus anterior circulation stroke. Scientific Reports. 2021 May 18;11(1):10544.
2. Rovira A, Grivé E, Rovira A, Alvarez-Sabin J. Distribution territories and causative mechanisms of ischemic stroke. European radiology. 2005 Mar;15:416-26.
3. Lin SF, Chen CI, Hu HH, Bai CH. Predicting functional outcomes of posterior circulation acute ischemic stroke in first 36 h of stroke onset. Journal of Neurology. 2018 Apr;265:926-32.
4. Aldag M, Kocaaslan C, Bademci MS, Yildiz Z, Kahraman A, Oztekin A, Yilmaz M, Kehlibar T, Ketenci B, Aydin E. Consequence of ischemic stroke after coronary surgery with cardiopulmonary bypass according to stroke subtypes. Brazilian Journal of Cardiovascular Surgery. 2018 Sep;33:462-8.
5. Zürcher E, Richoz B, Faouzi M, Michel P. Differences in ischemic anterior and posterior circulation strokes: a clinico-radiological and outcome analysis. Journal of Stroke and Cerebrovascular Diseases. 2019 Mar 1;28(3):710-8.
6. Slot KB, Berge E, Dorman P, Lewis S, Dennis M, Sandercock P. Impact of functional status at six months on long term survival in patients with ischaemic stroke: prospective cohort studies. Bmj. 2008 Feb 14;336(7640):376-9.
7. Han Y, Xu M, Zhao Y, Zhang Y. Long-term outcome and prognostic factors of posterior circulation ischemia patients: Results from a single center retrospective study. Vascular. 2020 Feb;28(1):25-30.
8. Taha NA, El Khawas H, Tork MA, Roushdy TM. Intravenous thrombolysis outcome in posterior vs anterior circulation stroke in a tertiary stroke center in Egypt. The Egyptian Journal of Neurology, Psychiatry and Neurosurgery. 2021 Dec;57:1-6.
9. Handelsmann H, Herzog L, Kulcsar Z, Luft AR, Wegener S. Predictors for affected stroke territory and outcome of acute stroke treatments are different for posterior versus anterior circulation stroke. Scientific Reports. 2021 May 18;11(1):10544.
10. Kwon H, Lee D, Lee DH, Suh DC, Kwon SU, Kang DW, Kim JS. Etiology-related outcome of endovascular therapy in posterior circulation stroke compared to anterior circulation stroke. Journal of Stroke. 2022 May 31;24(2):245-55.
11. Lengers BM. Posterior versus anterior circulation strokes: Comparison of treatment costs, and outcomes for Medicare patients. Medical University of South Carolina-College of Health Professions; 2015.