

Comparison of Clinical, Radiological and Outcome Characteristics of Ischemic Strokes in Different Vascular Territories

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Abstract

Background: Ischemic strokes are usually characterized by their etiology and the affected brain territory defined by the vascular supply. Strokes located within posterior circulation are considered by some as a condition with high morbidity and mortality. Recent findings suggest that stroke etiologies of posterior circulation strokes (PCS) and anterior circulation strokes (ACS) are more alike than dissimilar, suggesting that PCS deserve same investigations as ACS. The clinical and radiological characteristics and outcome between patients with PCS and ACS were compared.

Methods: Two hundred and twenty-two consecutive ischemic stroke patients with ACS and 81 patients with PCS were prospectively analysed.

Results: Patients with ACS and PCS did not differ in terms of demographic characteristics. Mean age in ACS group was 65 yrs and PCS group was 60 yrs. Prevalence of vascular risk factors like hypertension, diabetes, dyslipidemia, coronary artery disease, smoking, past history of stroke/TIA did not differ in two groups except for hypertension. The mean National Institute of Health Stroke score (NIHSS) at admission was 11 in ACS and 8 in PCS ($P = 0.04$). Brain imaging revealed pathological findings more in ACS group than PCS (CT, 72% vs. 67%; MRI, 90% vs. 80%). Cardioembolic stroke was more frequently seen in ACS than PCS (11% vs. 6%). IV thrombolysis was done in 9 patients with ACS and 3 patients with PCS. The proportion of patients with good clinical outcome (modified Rankin score 0 - 2) was similar in ACS and PCS (43% vs. 46% respectively, $P = 0.46$).

Conclusions: Demographic characteristics, etiology and outcome

are more alike than different in posterior circulation strokes and anterior circulation strokes.

Keywords: Ischemic stroke; Posterior circulation stroke; Anterior circulation stroke; Comparison; Prognosis

Introduction

Ischemic strokes are usually characterized by their etiology and the affected brain territory defined by the vascular supply [1]. However, there is insufficient data on the possible impact of anatomical stroke localization upon the clinical presentation, course, and outcome [2]. Stroke located within the posterior circulation are considered by some as a condition with high morbidity and mortality, since the relatively tight packaging of numerous ascending and descending tracts, as well as nuclei, within the brainstem enables even small lesions to produce very significant neurological deficits [3]. According to the New England Medical Center Posterior Circulation registry (NEMC-PCR), stroke mechanisms of anterior circulation strokes (ACS) and posterior circulation strokes (PCS) are more alike than dissimilar, suggesting that PCS deserve the same investigations as ACS [4]. The present study aims to compare the clinical, radiological and outcome characteristics of anterior circulation and posterior circulation strokes.

Patients and Methods

The present analysis include consecutive patients with a first ever acute ischemic stroke who were admitted to the stroke unit and neurology ward at Malabar Institute of medical sciences hospital, Kerala, India, from January 2010 to December 2010. Data were collected continuously and entered into prospectively maintained stroke data base. Stroke was defined according to the World Health Organization criteria as an acute focal neurological deficit with symptoms lasting longer than 24 hours [5] and corresponding findings on brain imaging. A diagnosis of ACS was based on at least two

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Table 1. Baseline Variables by Stroke Localisation

	ACS (n = 222)	PCS (n = 81)	P value
Gender (males), n (%)	139	57	0.2
Age(yrs) (mean)	64	61	0.3
Hypertension, n (%)	173 (78)	48 (59)	0.005
Diabetes mellitus, n (%)	104 (47)	37 (46)	0.9
Dyslipidaemia, n (%)	116 (52)	42 (52)	0.99
Coronary artery disease	71 (32)	19 (23)	0.31
Smoking, n (%)	87 (39)	35 (43)	0.59
Previous TIA/stroke	38 (17)	8 (10)	0.3
NIHSS score (mean)	11	8	0.04

out of the three features: hemiparesis (or hemisensory loss), dysphasia (or other cortical dysfunction) and homonymous hemianopia [6]. A diagnosis of PCS was based on brainstem or cerebellar signs or isolated homonymous hemianopia [6]. All patients underwent a standard aetiological work up, including blood tests (serum electrolytes, glucose, creatinine, haemoglobin, white cell and platelet counts, prothrombin time and cholesterol levels), 12 lead ECG, cranial CT and or MRI. The following ancillary investigations were carried out at the discretion of the treating neurologist: Doppler study of neck vessels, MR angiography and Echocardiography. The severity of the neurological deficits was assessed on admission by neurologist using the National Institutes of Health Stroke Scale (NIHSS). Antithrombotic therapy and secondary prevention was performed according to the international guidelines. The modified Rankin Scale score (mRs) was obtained at the time of discharge and 3 months after the occurrence of stroke.

Statistical analysis

Categorical variables were summarised as counts (percentage) and continuous variables as means (SD). The chi-square test was performed for cross tabulation. The following baseline variables were analysed and compared between patients with ACS and PCS: gender, age, NIHSS, arterial hypertension, diabetes mellitus, previous TIA, smoking, dyslipidemia, coronary artery disease. Usage of the ancillary investigations with their respective major findings was compared between PCS and ACS. To compare outcomes, we divided patients into two groups with favourable (mRs score 0 - 2) and non favourable (mRs score 3 - 6) outcome respectively.

Results

A total of 303 patients were diagnosed with ischemic stroke during the study period. Two hundred and twenty-two patients had ACS (73%) and 81 had PCS (27%). Demographic data and vascular risk factors were not statistically different between ACS and PCS except presence of hypertension and baseline NIHSS score (Table 1). The NIHSS scores were higher in ACS than in PCS (mean 11 vs. 8; $P = 0.04$).

MRI, CT and vascular imaging were performed at similar rate in ACS and PCS (Table 2). Abnormal findings were similar in both groups. There was no significant difference in the overall spectrum of aetiologies of stroke in the two groups.

Intravenous thrombolysis with recombinant tissue plasminogen activator (rtPA) was done in 9 patients with ACS and 3 patients with PCS.

Outcome

Good outcome was defined as modified rank in score of 0, 1 and 2 and mRS scores of 3, 4 and 5 were considered as bad outcome. Good outcome at discharge was observed in 43% of ACS group and 46% of the PCS group. Ten patients in ACS group and 3 patients in PCS group died. At 3 months, 66% of patients in ACS and 70% in PCS group had a good outcome.

Discussion

The present study aimed to compare clinical and demograph-

Table 2. Use of Diagnostic Resources and Findings

	ACS	PCS
MRI	117	47
MRI & CT	13	4
CT	92	30
Abnormal MRI	120 (90%)	40 (80%)
Abnormal CT	67 (72%)	20 (67%)
Vessel occlusion	30 (15%)	7 (17%)

ic characteristics, use of diagnostic and therapeutic resources as well as outcome between patients with ACS versus PCS treated in a tertiary hospital. Patients with PCS and ACS did not differ in terms of demographic characteristics and vascular risk factors except for the presence of hypertension, which was significantly more in patients with ACS. Brain imaging revealed pathological findings more often in ACS than in PCS. NIHSS scores on admission were significantly higher in ACS than in PCS.

Previous studies have pointed out limitations of the NIHSS score when comparing the neurologic severity of PCS and ACS [7-9]. Compared with patients with ACS, patients with PCS have higher probability of unfavourable outcome with low NIHSS scores. The reason is probably that the NIHSS is weighted towards the deficits of ACS rather than PCS. Moreover, an objective comparison of stroke severity between ACS and PCS remains challenging regarding the radiological findings. A study comparing CT findings to the clinical diagnosis of PCS found a lower correlation than between CT findings and clinical diagnosis of ACS. So experts consider MRI imaging the examination of choice for PCS [10]. Abnormalities on MRI were more frequently seen in ACS than PCS. Firstly, regarding the abnormalities on DWI, the vast majority of stroke patients underwent MRI during the first 24 h of symptom onset. However, during the first 24 h of symptom onset, 20% of patients with PCS had a false negative initial DWI study. There different reasons for low sensitivity of MRI for ischemic changes in the PC, including small lesion size compared with spatial resolution of DWI echo planar imaging, low signal to noise ratio and image artefacts in the brainstem and cerebellum [11]. As a consequence, a clinicoradiological comparison of stroke severity between ACS and PCS remains difficult.

We performed cardiac investigations (transthoracic

echocardiogram and ECG) in a similar rate in both ACS and PCS. This a good change from past when patients with PCS underwent less cardiac investigations than patients with ACS. Most of the previous studies showed cardioembolic strokes less frequently in PCS than ACS [12, 13]. The explanation might be related to vascular anatomy. Posterior fossa structures are vascularised by narrower arteries than those of anterior circulation [14]. Approximately two fifths of brain blood flow goes into each internal carotid artery and only one fifth into vertebra-basilar arteries. By chance alone, one fifth of cardiac-origin emboli should go to the posterior circulation. Using a Y-shaped bifurcation model, it was shown that large particles preferentially enter the wider bifurcation branch [15]. The interpretation of these findings was that large emboli would tend to preferentially go into common carotid, then the internal carotid and middle cerebral arteries rather than into the narrower bifurcation branches, such as the vertebral arteries. In an in vitro model of embolus microspheres encountering the circle of Willis, the embolus trajectory was dependent on embolus size and strongly favoured the middle cerebral arteries for large emboli [16]. We also found cardioembolic stroke more frequently in ACS than PCS (11% vs. 6%).

The 3 month outcome was favourable in 66% of ACS and 70% of PCS patients, and mortality was 9% in ACS and 7.5% in PCS. Even though the difference is not significant, patients with PCS had a better outcome compared to ACS. These findings demystify PCS as having a negative outcome, and goes along the relatively low mortality in patients with PCS, as reported in the NEMC-PCR [17]. Many other studies also reported a low rate of mortality and major disability in patients with posterior circulation strokes [18, 19]. Possible collateral circulation [20] and relative high threshold to ischemic damage [21] might explain in part the relative

resistance of posterior fossa tissue to ischemia. This explains the recent data showing that time window to open occlusions in the vertebrobasilar system might be longer than that in anterior circulation [22].

In summary this study confirms that the baseline variables and risk factors of strokes in PCS and ACS are more alike than different. Moreover, the present study further demystifies the adverse prognosis of PCS, showing almost similar outcome compared with ACS.

Competing Interest

None declared.

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