Original Article

Baseline Factors Affecting the Prognosis of Ischemic Cerebellar Stroke Patients in Turkey: A Cross-Sectional Study

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Abstract

Background: Cerebellar infarcts are encountered commonly in clinical practice; however, they are likely to be misinterpreted. They cannot be adequately evaluated on scales such as the National Institute of Health Stroke Scale (NIHSS), which can have fatal consequences. **Aim:** To evaluate the baseline features, prognosis, and 6-month survival in patients with cerebellar stroke. **Methods:** A total of 200 patients with cerebellar ischemia were included in the study. Patients were analyzed retrospectively from 10 years of data. Both univariate and multivariate analyses were evaluated. **Results:** Mean age was 68 years old, and men were more frequently affected. The most common symptoms were dysarthria and vertiginous sensations. Ischemic lesions were usually cortical/juxtacortical, multiple, hemispheric, and small (below 1.5 cm). The most commonly affected artery was the medial branch of the posterior inferior cerebellar artery. Cardioembolism was the more frequent etiology. Gait ataxia was associated with a more favorable prognosis and 6-month modified Rankin Scale (mRS) scores (OR: 0.15, 95% CI, $P = 0.03$). Older age (OR: 1.75, 95%, $P = 0.02$), female gender (OR: 6.72, 95%, $P = 0.02$), multiple (OR: 10.92, 95%, $P = 0.01$) and large lesions (OR: 6.56, 95% CI, $P = 0.01$), posterior circulation ischemic lesions extra-cerebellum (OR: 8.33, 95% CI, $P = 0.01$), left ventricular apical hypokinesia or AF (OR: 5.58, 95% CI, $P = 0.02$), and a high mRS score on admission (OR: 5.21, 95% CI, $P < 0.001$) was correlated with higher 6-month mRS and a lower survival rates. **Conclusion:** The study found that some baseline clinical, neurovascular imaging findings, and the mRS score on admission are useful predictors of cerebellar stroke prognosis and outcome.

Keywords: *Cerebellar stroke, cerebrovascular diseases, modified Rankin Scale (mRS), National Institute of Health Stroke Scale (NIHSS), neuro-critical care, stroke outcome*

Introduction

A total of 20 –30% of all ischemic strokes are classified as posterior circulation ischemia and may involve the cerebellum (2–5%) according to report of a stroke registry.[1] The mean age of these stroke patients is 65 years, males are affected more frequently than females.[2] Cerebellar ischemic lesions vary widely in size and location. The lesions observed in the cerebellum may occur solely or with other central nervous system (CNS) regions.[2,3] Large cerebellar infarcts (>1.5 cm) are classified according to the affected area or arterial perfusion site, but the vast majority of cerebellar ischemic events are small infarcts (≤1.5 cm) that may or not affect a vascular territory.[3]

Cerebellar infarcts are being encountered commonly in clinical practice due to improvements in magnetic resonance imaging (MRI).[1,3] On the other hand,

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cerebellar stroke symptoms, especially vertigo, are likely to be misinterpreted and cannot be adequately evaluated on scales such as the NIHSS, which can have fatal consequences.[3-5]

The aim of this study was to evaluate the clinical and radiological characteristics, prognosis, disability, and the 6-month survival rate of patients with ischemic cerebellar strokes.

Methods

Patient selection

This was a retrospective study that involved patients diagnosed with cerebellar vascular disease (ischemic) between January 2008 and January 2018 at the Gazi University Faculty of Medicine, Department of Neurology, Turkey. Data were obtained from the hospital's electronic recording system. Patients with acute and subacute ischemic stroke who presented to the emergency department with a cerebellar deficit and had cerebral and brain stem ischemic lesions with isolated cerebellar and/or cerebellum on imaging were included in the study. Chronic period (>1 month) ischemic lesions were not included in the study. Patients with cerebral, cerebellar, and brain stem hemorrhage, tumors, and infectious processes, and those whose data we evaluated in the hospital electronic record system were missing during hospital follow-ups, or those who did not attend regular outpatient follow-ups after discharge were excluded from the study.

Data collection

Age, gender, initial neurological symptoms, and examination findings were obtained. The result of electrocardiogram (ECG) rhythm, holter ECG, occurrence of malignant cerebral edema that causes fourth ventricle compression, management strategies, and comorbidities were recorded. Anti-thrombotic drug usage before the stroke and smoking habits was also recorded. The severity of the stroke was evaluated by using the NIHSS in the emergency room and discharge period. To evaluate their prognosis, the modified Rankin Scale (mRS) scores were calculated on admission, discharge, and 6 months post-stroke based on inpatient and outpatient records. The etiology of stroke was specified according to the ASCOD classification (A, atherosclerotic; S, small vessel disease; C, cardioembolic; O, other defined causes; D dissection).[6] The reports of brain imaging done by 16-slice computed tomography (BrightSpeed Elite 16 Slice CT Scanner; General Electric, Milwaukee, WI, USA) and MRI (1.5 and 3 Tesla Magneton Aera; Siemens, Erlangen, Germany) were recorded. MR angiography, echocardiography, and Doppler ultrasonography (Logic S8 and S9; General Electronic) reports were also retrieved. Vascular perfusion areas were determined via the review of Tatu *et al*.[7] CT reports were considered in 32 patients who had contraindications to having MRI imaging.

Ethical consideration

Approval by the ethics committee of Gazi University Hospital was granted in May 2018 (Number of Approval: 24074710-22).

Data entry and statistical analysis

IBM SPSS Statistics 17.0 (IBM Corporation, Armonk, NY, USA) was used for data entry and analysis. Descriptive statistics were performed. Categorical variables are shown as percentages (%) and numbers. If the expected frequency was less than 5 in at least one of the cells in 2 × 2 cross tables, the categorical variables were evaluated by using Fisher's exact test, also continuity-corrected Chi-square test was performed when the expected frequency was between 5 and 25. Pearson's Chi-square test was applied. Categorical variables were evaluated with the likelihood ratio test if the expected frequency in at least one cell was less than 5, otherwise (frequency >5) with the Pearson Chi-square test. The comparison between the two groups was done using the Mann–Whitney U test while Kruskal–Wallis test was used when the groups were more than two. If the Kruskal–Wallis test revealed significant results, the factors responsible for these differences were determined using Conover's test.

Patients with NIHSS scores of 0–3 at the discharge period were compared to those with scores of 4–12 and >13. Patients with mRS scores of 0 during the discharge period and the 6-month were compared to those with scores of 1–3, 4–5, and 6, based on stepwise multinomial logistic regression analysis. At the end of 6 months, the factors best able to predict survival were determined by stepwise multivariate logistic regression analysis. Significant variables ($P < 0.10$) in univariate analyses were included in the logistic regression models. Odds ratios, 95% confidence intervals (CI), and Wald statistics were calculated for each variable. The results were taken into account as significant at $P < 0.05$ in the regression analyses.

Results

The records of 4,763 patients were reviewed within the study period, and a total of 200 patients with cerebellar ischemic stroke were included. Cerebellar stroke occurs most frequently between the ages of 60 and 69 years. Mean age was 67,6 years old. In total, 44% of the patients were female and 56% were male. Table 1 presents detailed demographic and medical history data.

Slurred speech was the most frequently recorded symptom in 41.5%. This was followed by an imbalance in gait (36.5%), nausea and vomiting (34%), consciousness disorders (21.5%), vertiginous sensation like rotational spinning (21%) and dizziness like floating sensation, and/or unsteadiness (17.5%). When neurological examination findings were analyzed, dysarthria was the most common one in 40% of cases. Followed by gait ataxia (all directions or ipsilesional) (36%), dysmetria (25%), and confusion-lethargy (18.5%).

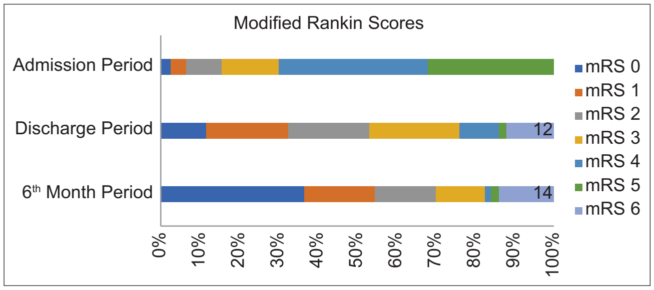

Figure 1: Bar graph frequency distribution in terms of admission, discharge, and 6th-month mRS levels. Although 70% of patients had an mRS score on admission of 4–5. At the 6-month follow-up, only 5% of patients had an mRS score of 4–5. At discharge, 70% of patients had an mRS score of 0–2 (including 35% with a score of 0); 12% died (mRS score of 6) during hospitalization. The total death rate was at 6 months which was 14%

Table 1: Patient demographic and clinical characteristics

	Number of cases
Age (y)	
18-29	1 (0.5%)
30-39	6 (3.0%)
40-49	16 (8.0%)
50-59	33 (16.5%)
60-69	54 (27.0%)
70-79	46 (23.0%)
80-89	38 (19.0%)
≥90	6 (3.0%)
Gender	
Female	88 (44.0%)
Male	112 (56.0%)
Comorbidities	
Recent MI	5 (2.5%)
CAD	48 (24.0%)
HT	145 (72.5%)
DM	71 (35.5%)
CVA	25 (12.5%)
TIA	8 (4.0%)
HPL	31 (15.5%)
Neurodegenerative conditions	19 (9.5%)
Anemia	12 (6.0%)
Coagulopathy	7 (3.5%)
Malignancy	12 (6.0%)
Post-surgical	5 (2.5%)
Smoking	25 (12.5%)
Prior antiaggregant/anticoagulant use	85 (42.5%)
Total	200 (100%)

MI: myocardial infarction (within last 6 weeks), CAD: coronary artery disease, HT: hypertension, DM: diabetes mellitus, CVA: cerebrovascular accident, TIA: transient ischemic attack, HPL: hyperlipidemia

Regarding radiological features, single and multiple cerebellar ischemic lesions were observed in 34.5% and 65.5% of cases, respectively. Among cases with multiple lesions, both unilateral and bilateral cerebellar lesions were observed. The rate of cortical/juxtacortical ischemic lesions was 74%, while 11% of cases showed deep white matter involvement and 15% showed both of these features. Regarding infarct size, 31.5% were larger than 1.5 cm in diameter. According to the cerebellar parenchymal anatomy, 184 (69.7%), 47 (17.8%), and 33 (12.5%) patients showed hemispheric, vermian, and peduncular involvement, respectively (multiple regions were evaluated because the lesions can occur on the left and right sides at the same time in the same patient, a total of 264 ischemic lesions evaluated in these 200 patients).

The percentage of ischemic lesions observed in extra-cerebellar infarct locations was 59%. In subgroup analysis, infarct location was classified as anterior circulation (AC), infratentorial region of the posterior circulation (PCIR), and supratentorial region of the posterior circulation (PCSR) in 16.5%, 26%, and 35.5% of cases, respectively. Occipital lobes and pons were the most affected locations in these areas. In 26% of patients' cerebellar ischemic lesion was accompanied by an extra-cerebellar infarct lesion in the PCIR. There were 52 patients in the PCIR group, 12 (23%) of them had ischemia in the medulla oblongata, 25 (48%) in the pons, and 15 (28.8%) in the mesencephalon. All patients with medulla oblongata involvement had PICA ischemias. Three (12%) of the ischemias in the pons were AICA, and 5 (20%) were in SCA territory. At the follow-up, 16% fourth ventricle compression, 3.5% hydrocephalus, 1% craniectomy (others treated with anti-edema medications), and 1% hemorrhagic transformation occurred.

According to cerebral, cerebellar, and brainstem vascular perfusion areas, the medial branch of the posterior inferior cerebellar artery (m-PICA) was the most commonly affected (46.5%), followed by the lateral PICA (1-PICA; 29.5%), medial superior cerebellar artery (m-SCA; 22%), non-territorial (17.5%), lateral SCA (1-SCA; 12.5%), and anterior inferior cerebellar artery (AICA; 10%). The proportions of cases showing PICA-AICA, PICA-SCA, and AICA-SCA border zone infarct locations were 2%, 3%, and 1.5%, respectively.

Table 2: Significance of factors distinguishing the patients with an NIHSS score of 0–3 at discharge from those with scores of 4–12 and 13+ (risk ratio, 95% CI, *P*)

	Odds ratio	95% confidence interval		Wald	*P*
		Lower limit	Upper limit		
NIHSS score of 4–12					
Gait ataxia	1.244	0.323	4.802	0.101	0.751
Confusion/lethargy	27.186	5.839	126.564	17.713	<0.001
Paresis	14.184	3.509	57.337	13.848	<0.001
PCIR (infratentorial)	2.908	0.867	9.757	2.989	0.084
PICA + AICA + SCA	1.505	0.060	37.815	0.062	0.804
NIHSS score of 13+					
Gait ataxia	0.034	0.003	0.431	6.821	0.009
Confusion/lethargy	11.260	2.500	50.705	9.945	0.002
Paresis	8.020	1.882	34.182	7.923	0.005
PCIR (infratentorial)	7.017	1.948	25.280	8.876	0.003
PICA + AICA + SCA	105.131	15.574	709.684	22.829	<0.001

PCIR: posterior circulation infratentorial region; PICA, posterior inferior cerebellar artery; AICA, anterior inferior cerebellar artery; SCA, superior cerebellar artery

Table 3: Significance of factors distinguishing the patients with an mRS score of 0 at discharge from those with scores of 4–5 and 6

	Odds ratio	95% confidence interval		Wald	*P*
		Lower limit	Upper limit		
mRS scores of 1–3					
Age	1.667	1.013	2.742	4.045	0.044
Disorder of consciousness	1.833	0.444	7.571	0.701	0.403
Dysmetria	9.862	1.823	53.356	7.060	0.008
Multiple infarction	0.266	0.082	0.858	4.914	0.027
Ventricle compression	0.504	0.080	3.184	0.531	0.466
Left cerebellar peduncular ischemia	5.411	0.530	55.275	2.028	0.154
PCIR (infratentorial)	14.793	1.739	125.814	6.085	0.014
mRS scores of 4–5					
Age	1.536	0.819	2.882	1.790	0.181
Disorder of consciousness	5.368	1.042	27.642	4.039	0.044
Dysmetria	2.917	0.351	24.254	0.981	0.322
Multiple infarction	0.595	0.124	2.861	0.419	0.517
Ventricle compression	0.882	0.090	8.637	0.012	0.914
Left cerebellar peduncular ischemia	13.184	1.069	162.561	4.049	0.044
PCIR (infratentorial)	35.803	3.639	352.219	9.409	0.002
mRS scores of 6					
Age	4.975	2.229	11.101	15.344	<0.001
Disorder of consciousness	38.039	5.315	272.224	13.131	<0.001
Dysmetria	5.608	0.469	67.023	1.855	0.173
Multiple infarction	1.843	0.249	13.632	0.359	0.549
Ventricle compression	23.376	1.724	317.005	5.614	0.018
Left cerebellar peduncular ischemia	15.972	0.999	255.391	3.838	0.050
PCIR (infratentorial)	162.660	12.661	2089.790	15.278	<0.001

PCIR: posterior circulation infratentorial region

Total ischemias in PICA, AICA, and SCA perfusion areas at the same time were seen in 9% of patients.

Based on the vascular imagining results, no pathology was present in 49.5% of patients other than minor changes such as a hypoplastic vertebral artery. Stenosis was seen in more than 50% of the lumen of the vertebral artery in 26.5% of cases. Moreover, 11% of cases showed basilar stenosis, 8.5% carotid stenosis, 8% vertebral dissection, 1.5% carotid dissection, and 4.5% other features (aneurysmal dilatation, etc.).

The ECG results were normal in 51% of patients, while a left atrial diameter of ≥4 cm was seen in 42.5% of

Table 4: Significance of factors distinguishing the patients with an mRS score of 0 at the 6-month follow-up from those with scores of 4–5 and 6

	Odds ratio	95% Confidence Interval		Wald	*P*
		Lower Limit	Upper Limit		
mRS scores of 1–3					
Age	1.231	0.885	1.712	1.520	0.218
Female gender	0.841	0.412	1.718	0.226	0.635
HPL	2.853	0.987	8.245	3.750	0.053
Gait ataxia	2.920	1.414	6.027	8.397	0.004
Multiple infarction	1.639	0.803	3.344	1.842	0.175
PCSR (supratentorial)	4.070	1.828	9.058	11.821	<0.001
PICA + AICA + SCA	0.341	0.053	2.205	1.277	0.258
mRS scores of 4–5					
Age	2.712	0.849	8.657	2.837	0.092
Female gender	21.835	1.513	315.034	5.127	0.024
HPL	111.697	6.160	2025.242	10.174	<0.001
Gait ataxia	21.365	0.964	473.318	3.752	0.053
Multiple infarction	0.126	0.004	3.695	1.442	0.230
PCSR (supratentorial)	78.324	2.915	2104.706	6.745	0.009
PICA + AICA + SCA	3.061	0.139	67.382	0.503	0.478
mRS score of 6					
Age	2.075	1.227	3.507	7.425	0.006
Female gender	4.964	1.467	16.802	6.635	0.010
HPL	1.680	0.312	9.057	0.365	0.546
Gait ataxia	0.659	0.164	2.659	0.342	0.558
Multiple infarction	5.493	1.426	21.165	6.126	0.013
PCSR (supratentorial)	2.513	0.749	8.428	2.228	0.136
PICA + AICA + SCA	16.089	2.865	90.355	9.956	0.002

HPL: hyperlipidemia, PCSR: posterior circulation supratentorial region, PICA: posterior inferior cerebellar artery, AICA: anterior inferior cerebellar artery, SCA: superior cerebellar artery

Table 5: Factors affecting survival at the 6-month follow-up

	Odds ratio	95% Confidence Interval		Wald	*P*
		Lower Limit	Upper Limit		
Age	1.753	1.097	2.800	5.512	0.019
Female gender	6.720	1.280	35.288	5.069	0.024
Gait ataxia	0.155	0.029	0.841	4.671	0.031
Multiple infarction	10.925	1.810	65.960	6.794	0.009
Ischemic lesion size >1.5 cm	6.568	1.493	28.892	6.202	0.013
PCIR (infratentorial)	8.332	1.588	43.703	6.286	0.012
Apical hypo-akinesia	0.061	0.006	0.667	5.254	0.022
NSR	1.000	-	-	-	-
AF/AFLT	5.588	1.264	24.702	5.149	0.023
PAF	7.352	0.231	234.031	1.277	0.259
Admission mRS	5.218	1.920	14.179	10.493	<0.001

PCIR: posterior circulation, infratentorial regions; NSR, normal sinus rhythm; AF, atrial fibrillation; AFLT, atrial flutter; PAF, paroxysmal atrial fibrillation

patients, and left ventricular apical hypokinesia in 16.5%. Mechanical heart valve, patent foramen ovale (PFO), ejection fraction (EF) <30%, and cardiac thrombus were present much less frequently. Normal sinus rhythm was present in 77.5% of patients. Atrial fibrillation (AF) and atrial flutter (AFLT) both were detected in 19.5% of patients, and paroxysmal AF in 3%.

The etiology of cerebellar ischemia was specified according to the ASCOD classification, as follows: C1, 28%; A1, 26%; A3, 11.5%; D1, 6.5%; C2, 6.5%; S1, 5.5%; and O3, 3.5%. The frequencies of the other etiologies were much lower.

Patients were grouped by NIHSS score (0–3, 4–12, 13–25, or >25). This grouping was made according to stroke severity as mild, mild to moderately severe, severe, and very severe stroke. According to admission to NIHSS, there were 113 (56.5%) patients with NIHSS 0-3, 69 patients with 4–12 (34.5%), 10 (5%) patients with 13–25, and 8 (4%) patients NIHSS with 25 and over. At discharge, there were 159 (79.5%) patients with NIHSS 0–3, 18 (9%) patients with 4–12, 1 (0.5%) patients with 13–25, and 22 (11%) patients with NIHSS with 25 and over. Discharge NIHSS of participants who died during hospitalization was calculated as the highest score. The mRS scores and survival data on admission, discharge, and 6th-month period are presented in Figure 1.

The NIHSS scores of the patients at discharge were significantly reduced when the patients presented with an isolated ataxic clinic at the time of admission ($P = 0.001$). Presentation with impaired consciousness ($P < 0.001$), the presence of an extra-cerebellar additional lesion in the infratentorial region ($P = 0.005$), and total involvement of PICA + AICA + SCA vascular areas ($P < 0.001$) increased the discharge NIHSS significantly. In terms of discharge mRS, increasing age ($P < 0.001$), impaired consciousness at admission ($P < 0.001$), the presence of multiple ischemic infarctions in the cerebellum ($P = 0.009$), ventricular compression ($P = 0.001$), the presence of an extra-cerebellar additional lesion in the infratentorial region ($P < 0.001$) showed scores of mRS > 3. Moreover, age ($P = 0.018$), female gender ($P < 0.001$), presence of multiple cerebellar infarct lesions ($P = 0.011$), having an extra-cerebellar additional lesion in the supratentorial and posterior circulation regions ($P < 0.001$), and total involvement of PICA + AICA + SCA vascular areas ($P < 0.001$) also made the mRS scores 4 and above in the 6th-month period.

Variables significant at $P < 0.10$ in univariate statistics were included in the multinomial logistic regression model as potential predictors of prognosis. Tables 2-5 show the significance levels of the factors included in logistic regression analyses of groups classified based on the NIHSS score at discharge, the mRS score at discharge, and the mRS score at the 6-month follow-up, respectively.

Discussion

This study evaluated the baseline of demographic, clinical, and radiological characteristics of patients and their effect on prognosis, disability status, and 6-month survival. Older age, female gender, presence of multiple lesions, large lesions, additional lesions in the posterior circulation, presence of AF, and a high mRS score on admission were associated with poor prognosis.

Two-thirds of cerebellar infarcts in patients aged over 65 years occurred in males as in previous studies.[2,8-13] Males had a higher stroke risk compared to females regardless of age, but postmenopausal females had a significantly higher risk of vascular events. The present study showed that the discharge rate and follow-up mRS score were significantly higher, while the survival rate was significantly lower in females compared to males in the postmenopausal age. This is likely because endothelial and platelet function is prone to disruption by thrombosis, and the capacity for new vascular formation is lower in postmenopausal women than men.[14]

As in previous studies, dizziness, nausea/vomiting, dysarthria, and headache were reported as the most common findings associated with cerebellar infarction.[9,10,15-18] Multiple, small cortical/juxtacortical ischemic lesions were associated with lower NIHSS and mRS. This suggests that there is a repetitive zonal organization pattern in the cerebellar cortex and that the smaller it is affected, the easier the compensation can be. However, it will be insufficient to make this comment about multiple ischemic effects. In previous studies, there was no clear data on the effect of multiple ischemic involvement in terms of prognosis. Multiple ischemias in our patients were generally small and some were in borderzones. It may be more appropriate to consider the location and size of the lesion together in terms of prognosis in multiple ischemic effects.[1,2,4,9,11] Significantly lower NIHSS scores at discharge were found in patients with only deep white matter or cortical/juxtacortical lesions compared to cases showing combined involvement. Combined involvement was associated with higher mRS scores at discharge and the 6-month follow-up, and higher mortality rates. The presence of small cerebellar ischemic lesions was associated with more favorable NIHSS and mRS scores on admission and discharge, as well as lower mRS scores at the 6-month follow-up and on survival rate. Patients with single lesions had significantly better outcomes at discharge and the 6-month follow-up than multiple. The small cerebellar ischemic infarcts are often presented in non-territorial, watershed vascular areas and are accompanied by dizziness and ataxia. In previous studies, small cerebellar infarcts having a milder clinical presentation and associated with better recovery rates have been reported.[1,3] Patients presenting with ischemia in combined arterial perfusion territories (PICA, AICA, and SCA) exhibit higher NIHSS, and mRS scores at discharge and the 6-month follow-up, and lower survival rates. Patients with m-PICA and l-SCA ischemia showed lower mRS, and NIHSS scores at discharge. In terms of vascular etiology, patients with basilar artery stenosis had high NIHSS scores at discharge, whereas those with vertebral artery stenosis had lower scores. The NIHSS and mRS scores at the discharge, and the mRS scores at the 6-month follow-up and survival rates were better in patients with a normal sinus rhythm. AF, AFLT, and paroxysmal AF were only associated with significantly increased mortality rates at 6 months as in previous studies.[19-23] Higher NIHSS scores were noted only in patients with a depressed level of consciousness. It has been believed that the NIHSS score cannot provide sufficient information for cerebellar stroke patients in the acute setting.[24]

In a study in which 79 cases were evaluated, it was observed that patients with hemorrhage had a worse outcome than patients with ischemic stroke, both at discharge and in the 6th month after discharge.[25] Cano reported that high frequency of hemorrhagic transformation (23%) and hydrocephalus (12%) were encountered in 124 patients with cerebellar infarction, whom he followed up for 5 years, especially when PICA was involved. It was stated that disability was higher (mRS >3) in patients with involvement in more than one arterial area, while mortality was 3.2%.[10] Calic stated that functional independence (mRS score 0–2) in 108 patients with the diagnosis of acute cerebellar infarct was 82% in those with small cerebellar infarcts (<2 cm), while it was 58% in those with large lesions (>2 cm). The functional outcome in the 3rd month did not differ in the PICA and SCA areas, the involvement of 2 or more vascular perfusion areas caused higher functional dependence in the 3rd month. The 3-month mortality was 9% in those with small lesions while this rate was 15% in those with large lesions.[26] Hemorrhagic transformation was also observed in 1% of patients in this present study. These two patients had malignant edema and therefore had ventricular compression. Decompression surgery was performed on one of the two patients, and the other died during hospitalization. The patient who underwent decompressive surgery was discharged as mRS 5, highly dependent, and died within the first 6 months of follow-up. One of the patients (who was decompressed) had an isolated PICA vascular perfusion area infarct, while the other had total AICA + PICA + SCA perfusion area involvement. This condition was also found as an independent risk factor in our analysis in terms of prognosis and survival. Small cerebellar ischemic lesions (<1.5 cm) were associated with better functional recovery and lower mortality rates, similar to those in previous studies.

The most important limitation of our study was the small sample size. However, we believe the sample was appropriate for the 10-year study period taking into account that cerebellar strokes constitute only 2–5% of all strokes. Another limitation was the insufficient data for some patients (67 patients) in the electronic records system, such that the final sample size was smaller than originally intended (267 patients). The lack of mRS scores before stroke was a further limitation. Finally, the effects of systemic complications, such as aspiration pneumonia, sepsis, and pulmonary thromboembolism, which increase mortality regardless of lesion location, were not accounted for in the analyses.

Conclusion

Older age, female gender, the presence of multiple lesions, lesions larger than 1.5 cm, additional lesions in the posterior circulation, the presence of AF, and a high mRS score on admission were associated with significantly higher morbidity and mortality. Patients with vertiginous symptoms on admission had a better prognosis than those presenting with a depressed level of consciousness. Higher NIHSS scores were noted only in patients with a depressed level of consciousness.

The overall prognosis and outcomes of these patients in previous studies were not different from those of other types of ischemic stroke, but these patients are difficult to evaluate accurately and precisely using current scoring systems.

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Conflicts of interest

There are no conflicts of interest.

References

1. Chaves CJ, Caplan LR, Chung CS, Tapia J, Amarenco P, Teal P, *et al*. Cerebellar infarcts in the New England Medical Center Posterior Circulation Stroke Registry. Neurology 1994;44:1385-90.
2. Edlow JA, Newman-Toker DE, Savitz SI. Diagnosis and initial management of cerebellar infarction. Lancet Neurol 2008;7:951-64.
3. De Cocker LJ, van Veluw SJ, Fowkes M, Luijten PR, Mali WP, Hendrikse J. Very small cerebellar infarcts: Integration of recent insights into a functional topographic classification. Cerebrovasc Dis 2013;36:81-7.
4. De Cocker LJ, Compter A, Kappelle LJ, Luijten PR, Hendrikse J, Van der Worp HB. Cerebellar cortical infarct cavities and vertebral artery disease. Neuroradiology 2016;58:853-7.
5. Stroke syndromes. In L. Caplan (Ed.), Caplan's Stroke: A Clinical Approach Cambridge: Cambridge University Press. 2016; pp. 217-566.
6. Amarenco P, Bogousslavsky J, Caplan LR, Donnan GA, Wolf ME, Hennerici MG. The ASCOD phenotyping of

ischemic stroke (Updated ASCO Phenotyping). Cerebrovasc Dis 2013;36:1-5.
7. Tatu L, Moulin T, Vuillier F, Bogousslavsky J. Arterial territories of the human brain. Front Neurol Neurosci 2012;30:99-110.
8. De Cocker LJ, Geerlings MI, Hartkamp NS, Grool AM, Mali WP, Van der Graaf Y, *et al*. Cerebellar infarct patterns: The SMART-Medea study. Neuroimage Clin 2015;8:314-21.
9. Tohgi H, Takahashi S, Chiba K, Hirata Y. Cerebellar infarction. Clinical and neuroimaging analysis in 293 patients. The Tohoku cerebellar ınfarction study group. Stroke 1993;24:1697-701.
10. Cano LM, Cardona P, Quesada H, Mora P, Rubio F. Infarto cerebeloso: Pronóstico y complicaciones de sus territorios vasculares [Cerebellar infarction: Prognosis and complications of vascular territories]. Neurologia 2012;27:330-5.
11. Amarenco P. The spectrum of cerebellar infarctions. Neurology 1991;41:973-9.
12. Caplan LR. Vertebrobasilar ischemia and hemorrhage: Clinical findings, diagnosis, and management of posterior circulation disease. Cambridge University Press; 2015.
13. Sarikaya H, Steinlin M. Cerebellar stroke in adults and children. Handb Clin Neurol 2018;155:301-12.
14. Tankó LB, Christiansen C, Cox DA, Geiger MJ, McNabb MA, Cummings SR. Relationship between osteoporosis and cardiovascular disease in postmenopausal women. J Bone Miner Res 2005;20:1912-20.
15. Kohn MA. HINTS to identify stroke in ED patients with dizziness. Acad Emerg Med 2014;21:347.
16. Newman-Toker DE, Kattah JC, Alvernia JE, Wang DZ. Normal head impulse test differentiates acute cerebellar strokes from vestibular neuritis. Neurology 2008;70:2378-85.
17. Muncie HL, Sirmans SM, James E. Dizziness: An approach to evaluation and management. Am Family Physician 2017;95:154-62.
18. Cnyrim C, Newman-Toker D, Karch C, Brandt T, Strupp M. Bedside differentiation of vestibular neuritis from central "vestibular pseudoneuritis". J Neurol Neurosurg Psychiatry 2008;79:458-60.
19. Barth A, Bogousslavsky J, Regli F. The clinical and topographic spectrum of cerebellar infarcts: A clinical-magnetic resonance imaging correlation study. Ann Neurol 1993;33:451-6.
20. Terao S, Miura N, Osano Y, Takatsu S, Adachi K, Noda A, *et al*. Multiple cerebellar infarcts: Clinical and pathophysiologic features. J Stroke Cerebrovasc Dis 2005;14:193-8.
21. Tada Y, Mizutani T, Nishimura T, Tamura M, Mori N. Acute bilateral cerebellar infarction in the territory of the medial branches of posterior inferior cerebellar arteries. Stroke 1994;25:686-8.
22. Petty GW, Brown RD Jr, Whisnant JP, Sicks JD, O'Fallon WM, Wiebers DO. Ischemic stroke subtypes: A population-based study of functional outcome, survival, and recurrence. Stroke 2000;31:1062-8.
23. Kolominsky-Rabas PL, Weber M, Gefeller O, Neundoerfer B, Heuschmann PU. Epidemiology of ischemic stroke subtypes according to TOAST criteria: Incidence, recurrence, and long-term survival in ischemic stroke subtypes: A population-based study. Stroke 2001;32:2735-40.
24. Siniscalchi A, Sztajzel R, Malferrari G, Gallelli L. The National Institutes of health stroke scale: Its role in patients with posterior circulation stroke. Hosp Top 2017;95:79-81.
25. Ng ZX, Yang WR, Seet E, Koh KM, Teo KJ, Low SW, *et al*. Cerebellar strokes: A clinical outcome review of 79 cases. Singapore Med J 2015;56:145-9.
26. Calic Z, Cappelen-Smith C, Cuganesan R, Anderson CS, Welgampola M, Cordato DJ. Frequency, aetiology, and outcome of small cerebellar ınfarction. Cerebrovasc Dis Extra 2017;7:173-80.