Original Article

Clinical and radiologic features and their relationships with neurofunctional scores in patients with acute cerebellar infarct

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Abstract

Background: Cerebellar infarct is a rare condition with very nonspecific clinical features. The aim of this study was to assess the full spectrum of the clinical characteristics, neuroimaging findings and neurofunctional analyses of cerebellar infarction, and the relationship between them. **Materials and Methods:** Data were collected from 59 patients admitted to our department during an 8-year period. We retrospectively analyzed the relationship between demographic characteristics, clinical symptomatology, etiological factors, functional condition, vascular distribution, frequency of subcortical white matter lesions (WMLs), and concomitant lesion outside the cerebellum in patients with acute cerebellar infarct (ACI) at time of admission. **Results:** The mean age in our series was 65.2 years, with most being male (57.6%). The posterior inferior cerebellar (PICA) artery was the most commonly affected territory at 62.7%. There was concomitant lesion outside the cerebellum in 45.7%. The main etiology in PICA was cardioembolism. While mean National Institutes of Health Stroke Scale on admission was 2.08 ± 1.67 in study group, modified Rankin Scale (mRS) on admission was detected to be mRS1 (*n*: 44, 74.5%) and mRS2 (*n*: 12, 20.3%) most frequently. Fourteen (35%) patients were detected to be in Fazekas stage 0; 11 (27.5%) patients in Fazekas stage 1; 6 (15%) patients in Fazekas stage 2; and 9 (22.5%) patients in Fazekas stage 3. **Conclusion:** Cerebellar infarct is very heterogeneous. The other cerebral area infarcts which accompany ACI negatively affect neurologic functional scores. Although it is difficult to detect the relationship between WMLs and neurologic functional severity, timely detection of risk factors and their modulation may be associated with prevention and treatability of WMLs, and this may be one of the important points for prevention of stroke-related disability.

Key Words

Cerebellar infarct, neurofunctional condition, radiological features, subcortical white matter lesion

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Introduction

Ischemic cerebellar infarction is a rare condition and accounts for between 1.5% and 20% of all ischemic strokes. It is common between the fifth and eighth decades of life, with men aged 60–65 being affected more often than women.[1-3] The risk factors for cerebellar stroke are the same as for strokes in other areas of the brain, but clinical manifestations in the acute stage are very nonspecific.

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Subcortical white matter lesions (WMLs) on magnetic resonance imaging (MRI) in the healthy elderly are common. Its prevalence is estimated from 5% to 20% in several population-based trials.[4-6] Increasing age and vascular risk factors such as hypertension (HT), diabetes are related to the degree of WMLs.[7] WMLs are associated with motor, cognitive,

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mood, urinary disturbances, and disability, but little is known about the prevalence of neurological signs in patients with these brain lesions.[8] In addition, WMLs are proposed to be a strong predictor for persistency of clinical symptoms, they are significantly associated with age in patients with isolated cerebellar infarct.[9] The relationship between WMLs and clinical symptomatology, functional condition is not known in patients with ACI, who have or do not have co-existing acute/chronic, supratentorial/infratentorial infarct.

Therefore, we investigated the relationship between demographic characteristics, clinical symptomatology, etiological factors, functional condition, vascular distribution, frequency of WMLs, and concomitant lesion outside the cerebellum in patients with ACI at time of admission.

Methods

Data collection

We performed a retrospective analysis admitted to our Neurology Department with a diagnosis of acute ischemic stroke during an 8-year period (2007–2015). Within this patient group, we selected and analyzed the 68 patients with a radiological diagnosis of ACI, with or without involvement of other vascular territories of the central nervous system. Patients were divided into three groups such as the ones with acute isolated cerebellar infarct (AICI) and without WMLs (Group 1) [Figure 1a and b]; the ones who have AICI and WMLs (Group 2) [Figure 2a and b]; and the patients who have acute/chronic, supratentorial/infratentorial vascular lesion in another area and WMLs in addition to ACI (Group 3) [Figure 3a-c]. A general sociodemographic data, medical history, clinical symptoms, and clinical signs were collected in all patients. Stroke subtype was classified according to Trial of ORG 10172 in Acute Stroke Treatment criteria.[10] The Neurological examinations to calculate modified Rankin Scale (mRS 1–5) and National Institutes of Health Stroke Scale (NIHSS) scores on admission were performed. Radiological diagnosis was evaluated by brain MRI using a standard protocol, including the following sequences: T1, T2, diffusion-weighted imaging, and fluid attenuation inversion recovery. Radiological images with artifacts were excluded from the analysis of the affected vascular territories. The evaluation study was conducted with the participation of neurologists, a very experienced radiologist. Patients were grouped by affected territory using Amarenco's Diagrams[11] such as superior cerebellar artery (SCA), anterior inferior cerebellar artery (AICA), and posterior inferior cerebellar artery (PICA). Also, the MRI assessment included visual ratings of WMLs according to the Fazekas *et al*.'s scale.[12] The study was performed in accordance with the Helsinki Declaration and approved by the Local Ethics Committee of the Necmettin Erbakan University, Meram Medical Faculty.

Statistical analysis

Statistical analyses were performed with Statistical Package for the Social Sciences 16.0 for Windows (SPSS, Chicago, IL, USA). For comparisons between the study groups, *t*-test (for normally distributions) and Mann–Whitney U-test (for abnormal distributions) were used for continuous variables and χ^2 test (for 3 or more × 2 variables) or Fisher's exact test (for 2 × 2 variables) for categorical variables. All significant levels were two-tailed and set at the level of 0.05.

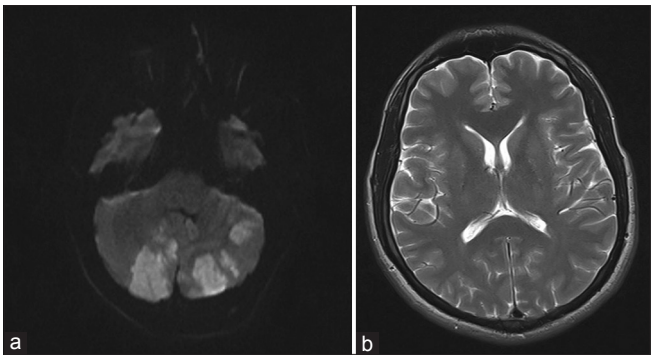

Figure 1: (a and b) Acute isolated cerebellar infarct without white matter lesions

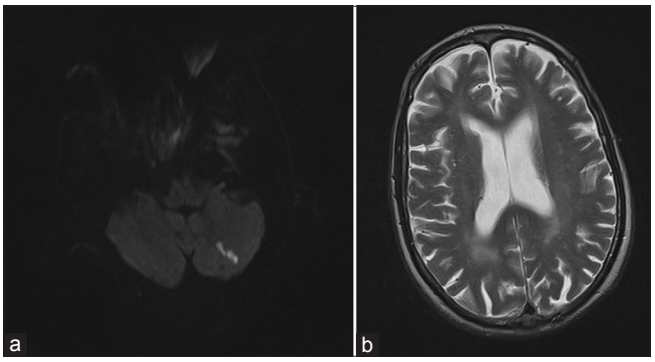

Figure 2: (a and b) Acute isolated cerebellar infarct with white matter lesions

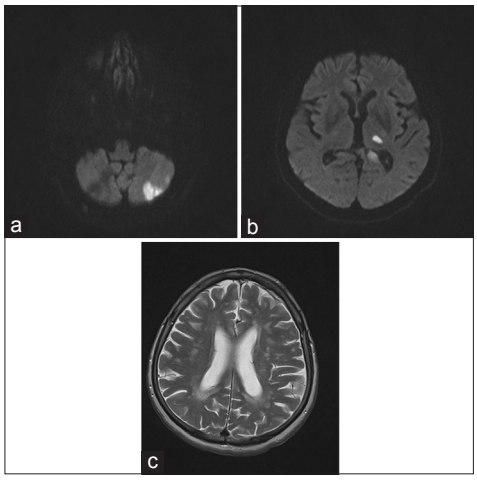

Figure 3: (a-c) Acute supratentorial vascular lesion in another area and white matter lesions in addition to acute cerebellar infarct

Results

The mean age of the study sample (n = 59) was 65.24 ± 12.50 (range: 33–86) years. Patient group was composed of 34 (57.6%) males and 25 (42.4%) females. HT (n = 35, 59.3%), diabetes mellitus (n = 13, 22%), coronary artery disease (n = 13,

22%), hyperlipidemia (*n* = 10, 17%), and nonvalvular atrial fibrillation (NVAF) (*n* = 8, 13.5%) were the most common diseases. The patients were detected to have been used antihypertensive (*n* = 29, 49.2%), acetylsalicylic acid (*n* = 12, 20.3%), oral anticoagulant (*n* = 9, 15.3%), oral antidiabetic (*n* = 8, 13.6%), insulin (*n* = 6, 10.2%), antilipemic (*n* = 8, 13.6%), clopidogrel (*n* = 3, 5.1%), and cigarette (*n* = 5, 8.5%) before ACI. There was the history of a previous cerebrovascular event (*n* = 7, 11.8%), neoplasia (*n* = 5, 8.4%) (prostate cancer in two patients, breast cancer in two female patients and larynx carcinoma in one male patient) [Table 1].

As shown in Table 1, patients with cerebellar infarct (*n* = 24, 40.7%) were classified as cardioembolic (*n* = 19, 32.2%), unknown (*n* = 7, 11.9%), small vessel disease (*n* = 7, 11.9%), and large artery disease (*n* = 2, 3.4%), other cause etiology.

When the study group was classified according to the frequency of isolated artery infarct area, isolated PICA (*n* = 37, 62.7%), isolated SCA (*n* = 5, 8.4%), isolated AICA (*n* = 3, 5%), and multiple artery area (*n* = 14, 23.7%) were found to be the affected areas. PICA + AICA involvement was detected in two patients and PICA + SCA involvement was detected in three patients in Group 1; PICA + AICA involvement was detected in three patients and PICA + SCA involvement was detected in one patients in Group 2; PICA + SCA involvement was detected in three patients, AICA + SCA involvement was detected in one patient, PICA + AICA + SCA involvement was detected in one patient in Group 3. There was no significant difference between the patient groups in terms of etiological classification and vascular territory.

Table 1: Sociodemographic data, medical history, etiological classification, and vascular territory of the patients

	Group 1 (*n*=19)	Group 2 (*n*=13)	Group 3 (*n*=27)	*P*
Sociodemographic data				
Age (mean±SD)	61.05±12.83	69.31±11.70	66.22±12.21	0.172
Sex, *n* (%)				
Male	12 (63.2)	8 (61.5)	14 (51.9)	0.435
Female	7 (36.8)	5 (38.5)	13 (48.1)	
Medical history, *n* (%)				
HT	10 (52.6)	9 (69.2)	16 (59.3)	0.706
DM	3 (15.8)	4 (30.8)	6 (22.2)	0.659
CAD	2 (10.5)	4 (30.8)	7 (25.9)	0.248
HL	2 (10.5)	4 (30.8)	4 (14.8)	0.800
NVAF	3 (15.8)	1 (7.7)	4 (14.8)	0.971
Stroke history	0 (0)	0 (0)	7 (25.9)	0.006
Antihypertensive	9 (47.4)	6 (46.2)	14 (51.9)	0.752
ASA	4 (21.1)	2 (15.4)	6 (22.2)	0.891
Anticoagulant	2 (10.5)	1 (7.7)	6 (22.2)	0.253
TOAST classification, *n* (%)				
Cardioembolism	7 (36.8)	4 (30.8)	13 (48.1)	0.408
Unknown	7 (36.8)	5 (38.5)	7 (25.9)	0.415
Small vessel disease	1 (5.3)	3 (23.1)	3 (11.1)	0.631
Large artery disease	3 (15.8)	1 (7.7)	3 (11.1)	0.664
Other cause	1 (5.3)	0 (0)	1 (3.7)	0.825
Vascular territory, *n* (%)				
Isolated PICA	13 (68.4)	6 (46.1)	18 (66.6)	0.488
Isolated SCA	1 (5.2)	2 (15.3)	2 (7.4)	0.953
Isolated AICA	0 (0)	1 (7.6)	2 (7.4)	0.323

HT = Hypertension, DM = Diabetes mellitus, CAD = Coroner artery disease, HL = Hyperlipidemia, NVAF = Nonvalvular atrial fibrillation, ASA = Acetylsalicylic acid, SD = Standard deviation, TOAST = Trial of ORG 10172 in Acute Stroke Treatment, PICA = Posterior inferior cerebellar artery, SCA = Superior cerebellar artery, AICA = Anterior inferior cerebellar artery

In Group 3, frontal region infarct accompanying to ACI was detected in 5 (18.5%) patients (3 were new-acute), temporal region infarct was detected in 3 (11.1%) (all were new-acute), parietal region infarct in 11 (40.7%) (9 were new-acute), occipital region infarct in 20 (74.1%) (14 were new-acute), thalamic region infarct in 5 (18.5%) (4 were new-acute), basal ganglion region infarct in 3 (11.1%) (2 were new-acute), and brain stem infarct was detected in 5 (18.5%) (3 were new-acute).

For the study group, while mean NIHSS was 2.08 ± 1.67 on admission, mRS on admission was detected to be mRS1 (*n*: 44, 74.5%) and mRS2 (*n*: 12, 20.3%) most. Of the patients in Groups 2 and 3, 14 (35%) were in Fazekas stage 0, 11 (27.5%) were in Fazekas stage 1, 6 (15%) were in Fazekas stage 2, and 9 (22.5%) were in Fazekas stage 3 [Table 2].

Imbalance (*n* = 47, 79.7%), vertigo (*n* = 46, 78%), nausea-vomiting (*n* = 23, 39%), dysarthria (*n* = 15, 25.4%), and weakness (*n* = 13, 22%) were the most common clinical symptoms. Dysmetria (*n* = 37, 62.7%), dysdiadochokinesia (*n* = 36, 61%), ataxia (*n* = 21, 35.6%), cranial nerve involvement (*n* = 8, 13.6%), and nystagmus (*n* = 6, 10.2%) were the most common clinical examination findings [Table 2].

Discussion

Cerebellar infarcts affect more males than females, which is true of ischemic strokes in general. Our data for age of onset and male: female ratio are similar to those published in other studies.[1,13-16]

Antihypertensive, acetylsalicylic acid, and anticoagulants were the most commonly used drugs before ACI. Oral anticoagulant use was more prominent in Group 3 (*n*: 6, 22.2%). This result may be explained with the high ratios of cardioembolic events and NVAF in the same group. In addition, history of a previous stroke was detected as 7 (25.9%) in Group 3. When we analyzed oral anticoagulant use and history of a previous stroke with regard to proportional frequency in Group 3, we may conclude that it may be associated with the high ratio of cardioembolic events.

In our study group, cardioembolic etiology was the most common. Cardioembolic etiology (*n*: 14) was in the foreground in patients with isolated PICA infarct (*n*: 37). Also, in Group 3, the patients with isolated PICA infarct (*n*: 18, 66.6%) composed almost two-third of the group. This result has put cardioembolic etiology in the foreground both in the whole study group, in Group 3, and in the isolated PICA infarct group. Although our data reflect the results of a small patient group, it reveals the need for pulling attention to etiologic screening and preliminary treatments, considering the scarce of data in literature.

Table 2: Clinical symptoms, clinical signs, functional scores, and frequency of white matter lesions of the patients

	Group 1 (*n*=19)	Group 2 (*n*=13)	Group 3 (*n*=27)	*P*
Clinical symptoms *n* (%)				
Imbalance	16 (84.2)	10 (76.9)	21 (77.8)	0.614
Vertigo	17 (89.5)	10 (76.9)	19 (70.4)	0.130
Nausea-vomiting	5 (26.3)	5 (38.5)	13 (48.1)	0.139
Dysarthria	3 (15.8)	4 (30.8)	8 (29.6)	0.314
Weakness	1 (5.3)	1 (7.7)	11 (40.7)	0.003
Clinical signs				
Dysmetria	12 (63.2)	9 (69.2)	16 (59.3)	0.756
Dysdiadochokinesia	14 (73.7)	7 (53.8)	15 (55.6)	0.239
Ataxia	5 (26.3)	4 (30.8)	12 (44.4)	0.199
Paresis	1 (5.3)	1 (7.7)	12 (44.4)	0.002
Cranial nerve involvement	1 (5.3)	1 (7.7)	6 (22.2)	0.091
Nystagmus	2 (10.5)	0 (0)	4 (14.8)	0.561
Functional scores, *n* (%)				
NIHSS (mean±SD)	1.47±0.61[a]	1.46±1.12[b]	2.81±2.09[a,b]	0.042
mRS1 mild disability	18 (40.9)	11 (25)	15 (34.1)	0.002
mRS2 moderate disability	1 (8.3)	2 (16.7)[a]*	9 (75)[a]	
mRS3 severe disability	0 (0)[a]	0 (0)[b]	3 (100)[a,b]	
Frequency of WMLs, *n* (%)				
Fazekas 0	0 (0)	5 (38.5)	9 (33.3)	0.753
Fazekas 1	0 (0)	2 (15.4)	9 (33.3)	0.240
Fazekas 2	0 (0)	1 (7.7)	5 (18.5)	0.375
Fazekas 3	0 (0)	5 (38.5)	4 (14.8)	0.098

*Same superscript letters denote the column proportions differ significantly at the 0.05 level. WMLs = White matter lesions, NIHSS = National Institutes of Health Stroke Scale, SD = Standard deviation

There are limited, various data about the ratios of coexisting infarcts detected in the other artery areas in patient groups where ACI was detected[16-18] and subgroup analyses of these data were not done. In addition, we could not encounter data about coexisting infarct areas in the other cerebral artery areas. Occipital and parietal infarcts accompanying ACI were detected to be the most frequent in our case Group 3. New-acute onset occipital infarcts coexisted with ACI in half of the case group (*n*: 14/27). While the etiologic factor was cardioembolic event in 8 of 14 patients, the cerebellar lesion was in isolated PICA area in 6 patients. Current data may suggest that particularly cardiac etiology should be kept in mind in the presence of the coexisting vascular area infarcts in ACI patients in whom isolated PICA area infarct was detected.

A statistically significant difference was detected between groups with regard to NIHSS on admission (*P*: 0.042). Mean NIHSS values on admission were significantly higher in Group 3 compared to the other group. In addition, the difference between groups with regard to mRS on admission was more evident in Group 3 and the difference was statistically significant (*P*: 0.002). When evaluated with regard to NIHSS, while mild neurologic deficit was detected in patients in Groups 1 and 2, mild-to-moderate neurologic deficit was detected in Group 3. With regard to mRS, while mild neurologic deficit was detected in 90% of the patients in Groups 1 and 2, moderate-to-severe neurologic deficit was detected in nearly half of the patients in Group 3. We consider that this has resulted from the characteristics of lesion load in Group 3.

A statistically significant difference was not detected between Groups 2 and 3 with regard to WMLs frequency. Limited data are available about the relationship between WMLs load and cerebellar infarct,[9] and this study proposes the presence of a correlation between WMLs load and functional scores as associated with age and also WMLs may be a strong predictor for persistency of clinical symptoms. Primarily, we want to emphasize that our study group is homogenous with regard to age. Our data have revealed that the patients in Group 3 are different from the patients particularly in Group 2 with regard to mRS2 and mRS3. However, this result does not enable us to associate the disease burden reflected to functional scores with only WMLs when it is evaluated together with all evaluable statistical data. In fact, it is quite difficult to make a comment about this issue which is affected from many variables such as lesion load ratio, neurologic deficit severity, clinical symptomatology, and etiologic factor. However, we consider that both study groups being well documented with regard to medical history, acute/chronic infarct characteristics accompanying to ACI, and homogenous relationship between groups should be considered when evaluating our data.

The most common clinical symptoms and the most common clinical examination findings on admission are similar with those of previous studies.[11,13,15,19] Weakness as a clinical symptom and paresis as a clinical finding were more evident in Group 3. This prominency which we considered to be directly associated with lesion burden of patient population consisting Group 3 has led to statistical significance (*P*: 0.003/0.002). It seems quite difficult to make an interpretation about whether and how this result was affected from WMLs in Group 3 due to the above-mentioned variables. In addition, current data were obtained at the time of admission and absence of longitudinal follow-up of data made to explain this issue difficult. Although it is quite difficult to detect the relationship between WMLs and severity of neurologic function, timely detection and modulation of risk factors may be associated with prevention or treatability of WMLs, and this may be one of the important points to prevent stroke-related disability.

Despite the presence of data about ischemic diseases of cerebellum and their clinical findings, insufficient number of patients in previous studies, absence of longitudinally recorded data of radiologic lesion load and clinical data and thereby not making a correlation between them, and using the data of single-center studies with unsimilar methodology indicate that this issue is untouched. The mentioned limitations are valid for our study also. Performing multicenter, prospective studies with similar methodology would provide significant data about better understanding of the ischemic diseases of cerebellum, creating different treatment modalities, fighting with the complications, and mortality and morbidity of the disease.

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Conflicts of interest
There are no conflicts of interest.

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