Journal of the Neurological Sciences 355 (2015) 68–71

Contents lists available at ScienceDirect

Journal of the Neurological Sciences

journal homepage: www.elsevier.com/locate/jns

Radiographic conjugate horizontal eye deviation in patients with acute cerebellar infarction☆

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ARTICLE INFO

Article history:
Received 19 December 2014
Received in revised form 9 May 2015
Accepted 11 May 2015
Available online 21 May 2015

Keyword:
Cerebellar infarction
Conjugate eye deviation
Head imaging
Neurological examination
Posterior inferior cerebellar artery
Flocculonodular lobe
Vermis

ABSTRACT

Backgrounds: Conjugate eye deviation (CED) has not been fully investigated in patients with acute cerebellar infarction. We investigated the incidence of CED on neurological examination and head imaging with acute cerebellar infarction and associations of CED with the involved vascular territory, lesion site and other clinical factors.
Methods: We retrospectively reviewed clinical records and imaging in patients with acute cerebellar infarction within 12 h after onset. We defined radiographic CED as deviation of each eye to the same side >10° on head imaging.
Results: Thirty-five patients with acute cerebellar infarction were identified (22 men; age range, 37–85 years). No patients showed CED on neurological examination, but 13 (37%) had radiographic CED, mostly contralateral to the lesion. As for infract location, the posterior inferior cerebellar artery (PICA) territory (44% vs. 20%, $p = 0.18$) and flocculonodular lobe and/or vermis (54% vs. 32%, $p = 0.20$) tended to be more involved in patients with radiographic CED than in those without.
Conclusions: Radiographic CED seems relatively common in patients with acute cerebellar infarction, particularly the PICA territory infarcts including the flocculonodular lobe and/or vermis.
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1. Introduction

Conjugate eye deviation (CED), defined as a sustained shift in horizontal gaze toward the same side, is a well-known phenomenon occurring in acute stroke patients. CED can occur as a result of acute stroke, for example, in the cortical frontal eye fields, brainstem paramedian pontine reticular formation (PPRF) and basal ganglia [1,2]. The presence of CED can also be evaluated reliably on head computed tomography (CT) in patients with acute supratentorial stroke [3]. Furthermore, head CT may enable to detect latent CED evident only when gaze fixation is removed by eye closure [3]. The association of CED with acute cerebellar infarction has not been fully investigated, and a few case series have described CED caused by cerebellar lesions without brainstem involvement [4–6].

The present study therefore sought to analyze the incidence of CED on neurological examination and head imaging in patients with acute cerebellar infarction, and to clarify the frequency and associations of CED with the involved territory, lesion site, infarct volume, and other clinical characteristics.

2. Methods

We retrospectively reviewed patients with isolated cerebellar infarction within 12 h after symptom onset using the database of stroke patients admitted to our hospital between January 2005 and December 2012. We collected their information such as sex, age, vascular risk factor, imaging finding and neurological symptoms including eye position, cerebellar syndrome and National Institutes of Health Stroke Scale (NIHSS) score on admission from medical records. The diagnosis of acute cerebellar infarction was confirmed on magnetic resonance imaging (MRI) with diffusion-weighted imaging (DWI) on admission. We excluded the presence of concomitant extracerebellar lesions by the initial and subsequent follow-up MRI. We excluded patients with bilateral cerebellar and those with a history of stroke or epilepsy. All study protocols were reviewed and approved by the local institutional ethics review board.

Head imaging was performed using CT scanners (Xvigor or Aquilion CX; Toshiba Medical System Corp, Tochigi, Japan) and 1.5-T MRI (Magnetom Sonata or Magnetom Vision; Siemens Medical Solutions, Erlangen, Germany), with slices parallel to the orbitomeatal line. Eye deviation on head imaging was estimated by CT and/or MRI (b0 images from the DWI echo-planar imaging sequence/fluid-attenuated inversion

☆ Study funding: Intramural Research Fund (H23-4-3) for Cardiovascular Diseases from the National Cerebral and Cardiovascular Center
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http://dx.doi.org/10.1016/j.jns.2015.05.018
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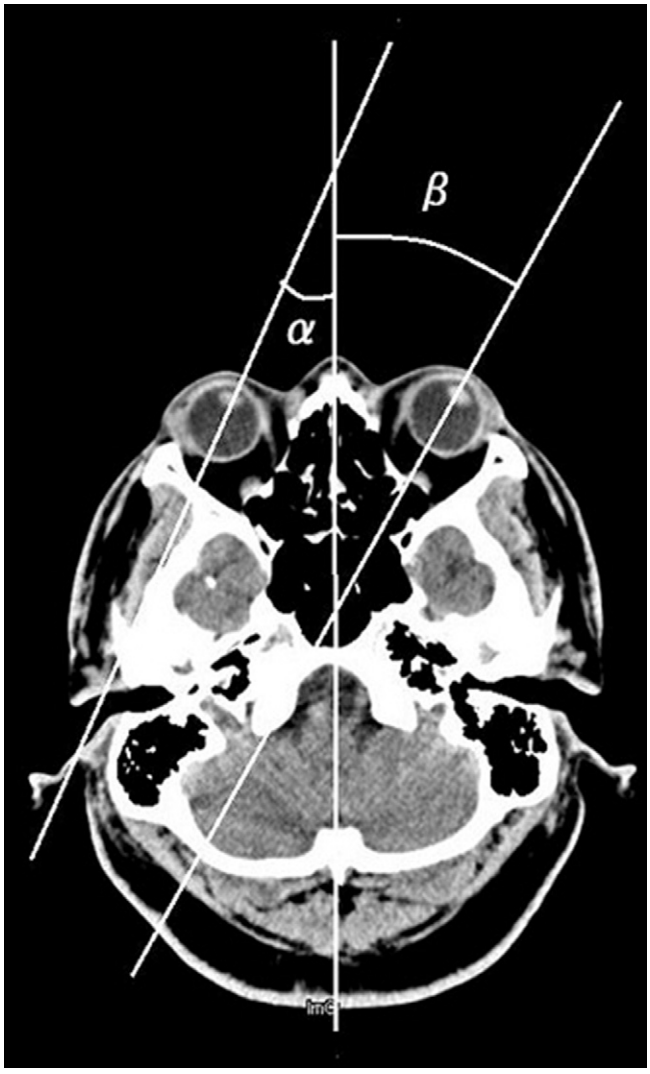

Fig. 1. Method for evaluating eye deviation on head imaging. Angles formed by the intersection of the ocular axes of the right (α) and left (β) eyes and the 'line of best fit' through the midline structures of the head were determined. Cited from Ref. [1].

recovery (FLAIR) images) on admission. To evaluate eye deviation on imaging, we used the technique described by Simon et al. (Fig. 1) [3].An average CED was calculated for each patient using the formula; $(\alpha/2) + (\beta/2) =$ average CED [7]. Radiographic CED (rCED) was defined as >10° of average CED on head imaging.

Cerebellar infarcts were classified into groups according to the brain map of the arterial perfusion territories: posterior inferior cerebellar artery (PICA); anterior inferior cerebellar artery (AICA); and superior cerebellar artery (SCA) territories [8]. When infarcts involved two or more territories, the dominant territory, which was larger infarcts, was chosen. The volume of cerebellar infarcts on DWI was assessed by multiplying the infarct area of all slices using image analysis software (ImageJ version 1.47, developed by the National Institutes of Health).

Univariate analysis was performed using the χ^2 test and Mann-Whitney U test between patients with rCED (rCED group) and those without rCED (non rCED group). Statistical analysis was performed using JMP version 10.0.0 statistical software (SAS Institute, Cary, NC). Values of $p < 0.05$ were considered statistically significant.

3. Results

Thirty-five patients with acute cerebellar infarction (22 men; age range, 37-85 years) were included in this study. Cardioembolism was the most common etiology (14/35, 40%). No patients showed CED on neurological examination. The presence of rCED was estimated by CT alone in 11 patients, MRI alone in 4 patients, and both CT and MRI in 20 patients on admission. When estimated by both CT and MRI, the results were always consistent between modalities. Consequently, rCED was identified in 13 patients (37%). A representative case in rCED group (Patient #6) is shown in Fig. 2.

Clinical characteristics of rCED and non rCED groups are shown in Table 1. Median age tended to be lower in rCED group (65 years) than in non rCED group (76 years, $p = 0.05$). Other clinical characteristics did not differ between two groups.

A summary of characteristics and lesion site for the 13 patients with rCED is shown in Table 2 and Fig. 3. Eleven of the 13 patients had cerebellar infarcts in the PICA territory. The rCED was directed contralateral to the infarct in 9 of the 11 patients with PICA territory infarcts and in 1 of the 2 patients with SCA territory infarcts. Six patients with PICA territory infarcts showed rCED without any other neurological deficits. All rCED resolved on follow-up imaging (median, 4 days after admission).

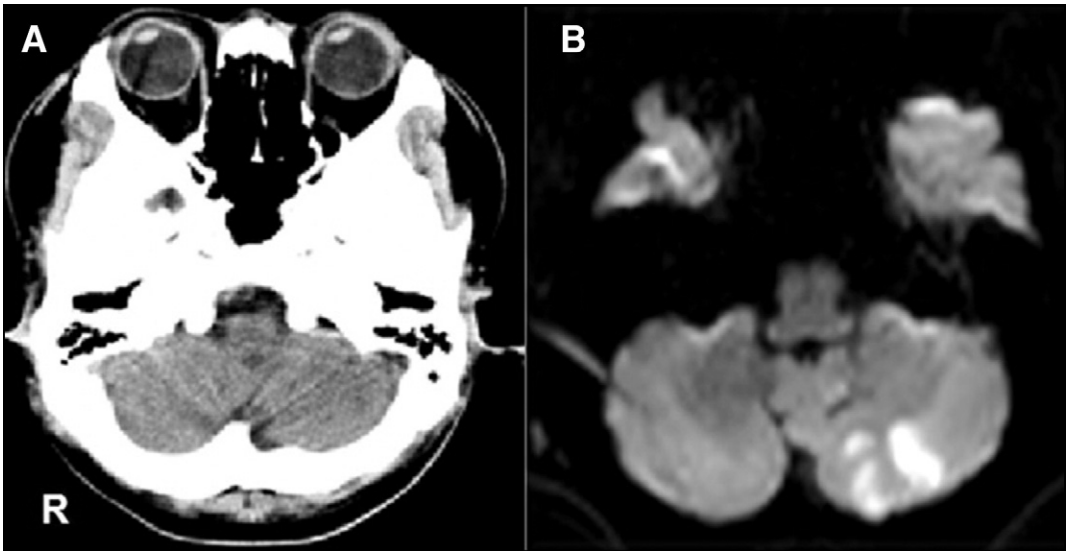

Fig. 2. A 37-year-old male complaining of vertigo without neurological deficit. Head CT on admission revealed conjugate eye deviation to the right (A) and diffusion-weighted imaging revealed acute cerebellar lesion in the territory of the left posterior inferior cerebellar artery (B).

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