Position of Cerebellar Tonsil and Brainstem in Chiari Malformations Type 1: A Difference Between 3 mm and 5 mm

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Introduction

Chiari malformation type 1 (CM-1) is diagnosed by more than 3 or 5 mm caudal displacement of the cerebellar tonsils through the foramen magnum. This definition is a simple and easy method neuroradiologically for any doctors, but it is obscure which is 3 or 5 mm of the tonsillar herniation. The purpose of this study is to analyze the differences of their clinical symptoms and radiological features using the position of tonsillar herniation and brainstem.

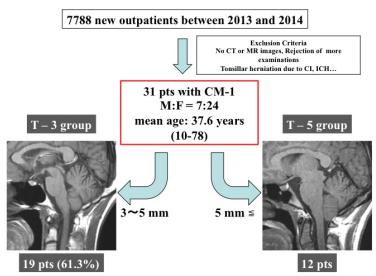
Methods

Thirty-one new outpatients diagnosed CM-1 between 2013 and 2014 were studied retrospectively. Their clinical symptoms and the following measurements were analyzed: the distances from the pontomedullary junction (PMJ) to the basion (PMJ-Ba), PMJ to the basion-opisthion (PMJ-BO), the distances from the basion-opisthion to tip of the cerebellar tonsil, from BO to the obex (BO-obex), and from basion to opisthion, the clivo-axial angle, and the

Results

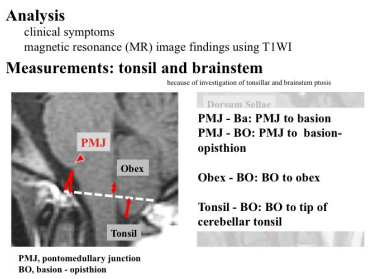
There were 7 men and 24 women aged from 10 to 78 years (mean: 37.6 years). All patients had no syringomyelia. In whom 19 patients with tonsillar herniation of less than 5 mm were determined as T-3 group (T-3) and remained 12 patients as T-5 group (T-5). Headache was the most common symptom (74.2%). Two patients after head injury and a patient with memory disturbance were diagnosed CM-1 incidentally in T-3 group. All measurements except the position of cerebellar tonsil had no significant differences between both groups.

Flow chart of selection of patients



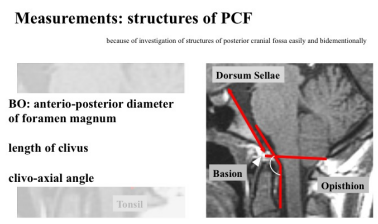
Patients of CM-1 were divided into two groups. The patients with tonsillar herniation of less than 5 mm were classified as T-3 group (T-3) and more than 5 mm as T-5 group (T-5).

Figure 1



This figure shows schema of four distances from pontomedullary junction to basion, from pontomedullary junction to foramen magnum, from obex to foramen magnum, and from tonsil to foramen magnum.We measured these because of investigation of tonsillar and brainstem ptosis.

Figure 2



This figure shows schema of clivo-axial angle, length of clivus, and diameter of foramen magnum.We measured because of investigation of structures of posterior cranial fossa easily(concisely) and bidementionally.

Table 1 summary of clinical symptoms

	T-3 (n=19)	T-5 (n=12)	Total
Sex (male:female)	4:15	3:9	7:24
Mean age ± SD (years)	41.4 ± 13.5 (13-78)	31.7 ± 17.3 (10-72)	37.6
Headache	9 (47.4%)	11 (91.7%)	20 (64.5%)
Vertigo/Dizziness	3 (15.8%)	4 (33.3%)	7 (22.6%)
Motor weakness	2 (10.5%)	1 (8.33%)	3 (9.68%)
Sensory disturbance	8 (42.1%)	2 (16.7%)	10 (32.3%)
Aphasia	0 (0%)	1 (8.33%)	1 (3.23%)
Dysarthria	1 (5.26%)	0 (0%)	1 (3.23%)
Tremor	1 (5.26%)	0 (0%)	1 (3.23%)
Incidental	3 (15.8%)	0 (0%)	3 (9.68%)

SD, standard deviation

Table 2 summary of radiological measurements

(mm)

	T-3 (n=13)	T-5 (n=11)	P value
PMJ-BO (mm)	13.0 ± 3.15	11.5 ± 3.21	NS
PMJ-Basion (mm)	13.4 ± 3.15	11.9 ± 3.11	NS
Tonsil-BO (mm)	− 4.03 ± 0.59	− 5.98 ± 0.45	P < 0.05
Obex-BO (mm)	8.49 ± 2.82	7.57 ± 2.13	NS
Length of clivus (mm)	42.6 ± 2.98	42.3 ± 5.77	NS
Clivo-axial angle (degree)	149.6 ± 7.29	148.6 ± 7.98	NS
Basion-Opisthion (mm)	35.1 ± 2.17	35.2 ± 2.77	NS

NS, no significant

The measured values are expressed as negative if the tip of the tonsillar is positioned below the foramen magnum.

Discussion

In 1985, Aboulezz et al reported borderline of a normal position of cerebellar tonsil was between 3 mm and 5 mm.

The radiological definition of chiari malformation type 1 (CM-1) has been reported as tonsillar herniation of at least 3 mm or 5mm below the foramen magnum (Barkovich AJ et al., 1986). This definition is simple and easy to use for any doctors, but limited to a single criterion and makes no reference to clinical symptoms or the presence or absence of associated findings such as syringomyelia. Milhorat et al in 1999 reported 9% (32/364) with tonsillar herniation of less than 5 mm had symptoms that were typical Chiari malformation type 1, and in whom 17 patients had syringomyelia (53%).

In this study, there were no syringomyelia, and all clinical symptoms may not be associated with chiari malformation, because the number of patients was very small. This was one of the limitation of this study.

So, Chiari malformation type 1 should be diagnosed based on not only tonsillar herniation but also clinical symptoms associated with chiari malformation and other MRI findings such as braistem ptosis.

Several limitations of our study should be mentioned.

Firstly, the number of the CM-1 patients was small, because this hospital was special hospital for neurosurgery and there were only three neurosurgeons.

Secondly, some patients were not diagnosed CM-1 because of differential skills for diagnosis of these doctors or without patients' cooperations.

Conclusions

The patients in both groups had similar sympotms and posterior cranial fossa structures. Chiari malformation type 1 should be diagnosed based on the position of the cerebellar tonsil associated with clinical symptoms and other MRI findings such as brainstem ptosis using pontomedullary junction.