Relationship between Virchow-Robin space dilatation on magnetic resonance imaging (MRI) and migraine headaches

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Abstract

Objective: Virchow-Robin (VR) spaces are perivascular spaces that surround the perforating arteries of the brain. These spaces are usually microscopic, but when they dilate, they may be seen on magnetic resonance imaging (MRI). The aim of this study was to investigate the relationship between VR space dilatation on brain MRI and symptom of headache in migraine headaches.

Methods: In this cross-sectional study, two groups of patients with (30 patients) and without migraine headaches (30 patients) who referred to our academic radiology department to undergo MRI examination, were included. VR space dilatation was considered as a size of larger than 2 mm. Results: VR space dilatation was seen in 29 patients (48.3%). This was significantly more common among patients with migraine headaches (20 patients, 66.7%) than in patients without headaches (9 patients, 30%); P= 0.009.

Conclusion: VR space dilatation seen on brain MRI is a relatively common radiologic finding among patients with migraine headaches and found to be more common than in patients without headaches. This radiologic finding can be considered as an important finding in the assessment of patients with migraine headaches.

Key words: Virchow-Robin space; headache; migraine; magnetic resonance imaging; brain

Introduction

Virchow-Robin (VR) spaces are small, perivascular spaces that surround the perforating arteries of the brain and expand from the subarachnoid space to the cerebral parenchyma (1). There is evidence about the function of these spaces, such as acting as a channel for the drainage of interstitial fluid as well as having immunological function (2). These spaces are usually microscopic, but when dilated, they may be seen on magnetic resonance imaging (MRI) of the brain. Typically, dilated spaces are seen as cystic dilatation with cerebrospinal fluid (CSF) signal (3). MRI is the sole imaging method capable of evaluating the anatomical details of VR spaces (4, 5).

The dilatation of VR spaces has been reported in some pathological conditions of the brain including vascular, inflammatory, neoplastic, metabolic and traumatic brain conditions (2, 6). One of the important conditions in this regard is migraine headache. Migraine is a relatively common debilitating disorder (about 14% in the United States), which is diagnosed using clinical criteria. In general, it is not necessary to perform imaging of the brain in patients with typical migraine symptoms. Neurological imaging has, however, been the focus of recent attention in some studies. Imaging studies have shown new evidence of changes in the brain of migraine patients and these findings can be effective in following and choosing therapies, although these are still at the research stage (8).

One of the imaging findings of the brain in migraine patients is VR space dilatation. There is controversy about VR dilatation in migraine headache. In some studies, it has been shown that the number of dilated VR spaces in these patients is clearly and significantly increased (9-12). Three studies have been conducted on children (10-12). In one study, the average age of the patients was 42 years (9). A case report presented an adult patient who had a migraine headache with a very large dilatation of VR space (3). Contrary to these results, in a recent study, there was no significant difference in the frequency of this finding between adult patients with migraine headache and those without headache (1).

The aim of this study was to determine the frequency of VR space dilatation in patients with migraine headache and compare it with patients without migraine headache. Considering the fact that VR space dilatation may be seen even in patients without headache, investigation as to whether the presence of VR dilatation in patients with migraine headache has a significant relationship with this disease is important. Therefore, if there is a meaningful relationship between VR dilatation and migraine headache, the importance of mentioning this finding in the interpretation of brain MRI in patients with headache complaints can beestablished. Given the fact that no specific criteria for imaging migraine has yet been identified, it may be possible to use this radiologic finding in developing more useful radiologic criteria for migraine headaches.

Materials and Methods

Study Design and Population

In this cross-sectional study, two groups were included. One group (case group) included patients with migraine headache symptoms and because of neurological disorders, according to a board-certified neurologist consultation, imaging with MRI was considered necessary. Migraine headache was diagnosed using the diagnostic criteria proposed by the International Headache Society (13). The second group (control group) included patients who did not have migraine headaches and were referred to the radiology department to undergo MRI examination for various reasons. The age range of 15-50 years old was considered for inclusion in the study. Exclusion criteria in the two groups were history of ischemic attacks or evidence of atherosclerosis, multiple sclerosis, previous history of white matter neurodegenerative diseases, history of granulomatous and rheumatic diseases such as systemic lupus erythematosus (SLE) and history of infectious diseases such as tuberculosis, and metabolic diseases. Also, patients who had a history of smoking were not included. In addition, observation of any incidental finding on brain MRI was considered as an exclusion criterion.

Sample size

The sample size was estimated using the findings of a similar study (9) in which the frequency of VR space dilatation rates on brain MRI of patients with migraine headache and without headache symptoms were reported as 40% and 7%, respectively. Considering a confidence level of 95% and a power of 90%, the minimum sample size was calculated as 30 patients in each group.

Data collection

The Data gathered included demographic characteristics (age, gender, body mass index), clinical signs and MRI data. The instrument used was a Philips MRI machine with a magnetic field intensity of 1 Tesla. Based on the MRI of the brain, the size of the VR space of more than 2 mm was considered dilated VR space (1). MRI images were interpreted by a radiologist who was unaware of the patients' characteristics.

Data analysis

The mean, standard deviation (SD) and frequency were used to report the data. To compare the quantitative variables between the two groups, the independent t-test or Mann-Whitney U test were used. The U-Mann-Whitney test was used to compare the age distribution of patients with and without migraine headache symptoms. The Chi-square test was used to compare the qualitative variables. The significance level was considered as 0.05. The SPSS software (Ver. 22.0) was used for data analyses.

Results

Mean (±SD) age of the patients was 37.28 (±11.75) years (range, 18-60 years). There were 56 females (93.3%) and two males (6.7%). Mean (±SD) BMI was 4.32 (±4.60) kg/m2 (range, 19.53 to 34.37).
Sixteen patients (26.66%) had a medical condition including hypertension (4 patients, 6.7%), hypothyroidism (2 patients, 3.3%), cardiovascular disease (one patient, 1.7%), seizure (3 patients, 5%), epilepsy (3 patients, 5%), and brain astrocytomas (3 patients, 5%). The comparison of demographic variables between the two groups is shown in Table 1.

Table 1. Comparison of demographic data between patients with and without migraine headaches

	Migraine headache group (N= 30)	Control group (N= 30)	P value
Age, year	39.47 (±12.18)	32.16 (±9.05)	0.023
Gender, female	29 (96.7%)	27 (90%)	0.612
BMI, kg/m²	26.92 (±4.36)	24.42 (±4.03)	0.194
Medical condition	7 (23.3%)	9 (30%)	0.99

The dilatation of VR space was observed in 29 patients (48.3%). Anatomical location of the dilatation was basal ganglia (28 patients, 93.3%) and hemispheric white matter (2 patients, 6.7%). VR space dilatation was diagnosed in 20 patients of the migraine headache group (66.7%) which was significantly more prevalent than that observed in the control group (9 patients, 30%); P = 0.009.

Of 20 patients with migraine headache who had dilated VR spaces, the anatomical location of the lesion was in the basal ganglia in 19 patients (95%), and only one patient had VR dilatation in the hemispheric white matter . VR dilatation was diagnosed in the basal ganglia in all 9 patients of the control group. There was no significant difference in the anatomical location of the lesion between the two groups.

Discussion

According to the results of this study, about two thirds of patients with migraine headache had dilated VR spaces on brain MRI. The prevalence of this finding was significantly higher in patients with migraine than in patients who did not have headaches. VR spaces with round, ovoid, or linear appearance have signal intensity similar to the CSF. In previous studies, the basic ganglia and hemispheric white matter have been reported as the most common anatomic locations for dilated VR spaces (1-3, 14, 15).

Few studies have compared the frequency of VR space dilatation of patients with migraine headache symptoms and those without migraine headache symptoms. A study by Schick et al., compatible with our findings, concluded that based on the findings of MRI, VR dilatation was observed in 61% of patients with migraine headache and in 22% of patients with tension headache. Therefore, recognizing the dilated VR space can be helpful in improving primary headache management in children (10). In another study in adult patients, in agreement with the presented results, the dilatation of VR space in the group of patients with migraine headache was 40% and in the group of patients without headache was only 7% (9). In a study by Biedroń et al., it was shown that among children with dilated VR space, 28.3% of the patients were diagnosed with headache. The most frequent anatomic location was in the subcortical area. There was no relationship between the location of dilated VR space and symptoms of the patients, except that a large dilated VR space could lead to pressure on the surrounding tissues (12). In a study by Husøy et al., the basal ganglia and hemispheric white matter were the most common reported locations for dilated VR spaces (1). However, in contrast to the above mentioned findings, there was little difference in the frequency of perivascular space dilation of patients with migraine headache and those without migraine headache (1). However, patients with a migraine headache without aura had a smaller perivascular space than those without headache in the basal ganglia (1).

In a study by Rollins et al., it was shown that there was a relationship between neurological disorders such as headache in children and the existence of dilatation of VR space based on MRI findings (11). Relation between dilatation of VR space and physiological aging, hypertension and dementia has been reported. There is a clear correlation between the age and VR dilatation which indicates that this is another phenomenon that is related to the aging of the brain, similar to that which occurs in the subarachnoid space (1).

Pathogenesis of the headache is an ongoing topic with two main theories proposed. These are vasodilatation caused by vasodilatation and neurogenic process associated with secondary vasodilation associated with sterile neurogenic inflammation. But in a new theory about headache pathogenesis, factors such as defects in controlling estrogen-dependent microvascular integrity which leads to the extraction of plasma proteins, potential activation of perivascular space and neurons associated with connective tissue stroma related to pain and the release of inflammatory responses were discussed (16). VR spaces are potentially one of the most important pathways for soluble proteins like leukocytes to enter the central nervous system (16), which are associated with the transfer of soluble factors between the extracellular fluid of the brain and the CSF.

Limitations

The current study had some limitations. We were not able to follow patients and find out the association between VR space dilatation with migraine headache attacks. Only migraine headache patients were enrolled and other types of headache such as tension-type headache and cluster headache were not included.

Conclusion

The dilation of VR space was relatively common in migraine headache patients. This finding was significantly more common in the migraine group than in the control group. This radiologic finding can be considered as an important criterion in examining patients with migraine headaches.

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