

## Original Article

## Isolated Vertigo and Possibility of Brain Ischemia

Arash Mosarrezai MD<sup>1</sup>, Mansoureh Toghae MD<sup>•2</sup>, Masoud Majed MD<sup>2</sup>, Mehdi Aloosh MD<sup>2,3</sup>**Abstract**

**Background:** In cases of isolated vertigo, physicians are unable to definitely distinguish between central and peripheral vertigo by history and physical examination. Some central causes of isolated vertigo such as cerebellar stroke can be life-threatening and require intervention. On the other hand, brain infarction can be detected shortly after the onset of clinical symptoms by using diffusion-weighted MRI (DWI). We have conducted this study to perform DWI in isolated vertigo patients with a higher probability of brain infarction.

**Methods:** We enrolled 55 consecutive patients with isolated vertigo who had at least one cardiovascular risk factor. A questionnaire that consisted of cardiovascular risk factors was completed and DWI performed for each patient. We analyzed the association of cardiovascular risk factors with infarction as identified by DWI.

**Results:** Using DWI, 5 (9.1%) patients had an acute ischemic stroke. Among cardiovascular risk factors, analysis showed a significant relationship between diabetes mellitus (DM) and infarction.

**Conclusion:** Isolated vertigo may occur due to the occlusion of a small artery in the area of brain circulated by the posterior inferior cerebellar artery. According to our results, DWI may be used in diabetic patients with isolated vertigo to locate a probable infarction.

**Keywords:** Cardiovascular risk factors, diabetes mellitus, diffusion weighted MRI, isolated vertigo

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**Introduction**

The first step for assessing vertigo is to differentiate between central and peripheral vertigo. Central causes of vertigo need more attention and further evaluation.<sup>1</sup> Central vertigo is commonly associated with dysarthria, diplopia, ataxia or other neurological deficits, and bidirectional nystagmus.<sup>2</sup> In contrast, peripheral vertigo is usually positional, more severe, and associated with nausea and vomiting, as well as unidirectional nystagmus. However, in patients who present with vertigo in the absence of other neurological signs (isolated vertigo), there is no definite clue to distinguish between the central and peripheral types of vertigo.<sup>3</sup> Recurrent isolated vertigo that lasts for several minutes may be caused by vertebrobasilar insufficiency, although transient ischemia of the vestibular labyrinth, which is supplied by the internal auditory artery originating from the anterior inferior cerebellar artery (AICA), is a rare cause of isolated vertigo.<sup>4,5</sup>

According to previous studies, one-fourth of acute isolated vertigos could be a result of cerebellar infarction.<sup>6</sup> Brain infarction can be identified shortly after the onset of clinical symptoms by diffusion-weighted MRI (DWI). Several studies have reported its high sensitivity and specificity in diagnosing acute cerebellar infarction.<sup>7</sup> Therefore, this study aims to perform DWI on identified isolated vertigo patients who have a higher probability of brain infarction.

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**Materials and Methods**

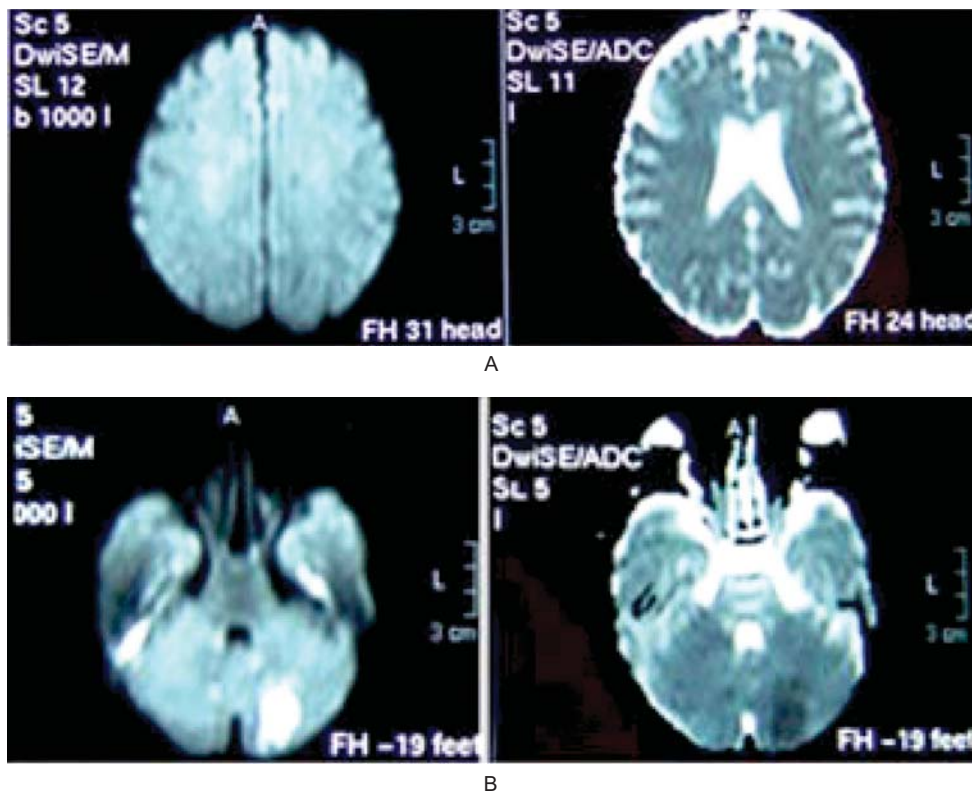
After receiving approval from the Tehran University of Medical Science ethic's committee, this cross-sectional study was conducted on a group of acute isolated vertigo patients (30 male and 25 female) aged 32–84 years who referred to the authors' neurology department. After signing written informed consents, 110 consecutive patients completed a questionnaire that consisted of major risk factors of ischemic cardiovascular disease. The questionnaire items were sex (being male was considered a risk factor), age, hypertension (HTN), diabetes mellitus (DM), hyperlipidemia (HLP), smoking, history of ischemic heart disease, myocardial infarction (MI), or stroke. DWI was performed on participants within a three-day period from onset of symptoms. The presence of acute infarction was assessed based on DWI.

Exclusion criteria were the presence of any neurological deficits, vertigo for more than two weeks, and contraindications for MRI. After excluding ineligible cases, we included 55 patients in the study. This study was conducted to identify isolated vertigo patients with a higher probability for brain infarction. We used SPSS version 15 for data analysis. The association between cardiovascular risk factors and brain infarction was analyzed by the Chi-square test. Fisher's exact test was used to interpret the results in subgroups.

**Results**

Of those enrolled, 32 were hypertensive, 11 were diabetic, and 29 had abnormal lipid profiles. There were 16 patients who had histories of ischemic heart disease, 3 with myocardial infarction, 5 had histories of stroke, and 21 had smoking histories.

DWI showed acute ischemic stroke of the posterior circulation



**Figure 1. A)** Normal DWI (left side) and ADC map (right side). **B)** DWI images (left side) show a hyperintense area in the left hemisphere of the cerebellum of a patient with isolated vertigo, which has a low ADC value (right side).

area in 5 (9.1%) patients. Fisher's test showed a significant relationship between DM and brain infarction as seen by DWI ( $P = 0.05$ ) (Figure 1).

## Discussion

The first step in diagnosing vertigo is to distinguish its central or peripheral origin. Central acute vertigo could be a sign of cerebellar or brainstem infarction. Although the size of the infarct may be small, it needs attention and preventive measures for possible future ischemic events. On the other hand, infarctions involving the inferior cerebellum can produce cerebellar swelling which may lead to brain-stem compression, coma, and death,<sup>8-10</sup> necessitating close observation.

In the present study, according to DWI results, 5 (9.1%) patients with acute isolated vertigo had evidence of cerebellar ischemic infarction. In a small study on 24 elderly patients with isolated vertigo, 25% had caudal cerebellar infarcts. However, that study was limited because of its specific age group.<sup>11</sup> Some studies reported the additional finding of infarction among acute isolated vertigo patients, although it was not the main study objective. In a prospective study Kumral et al. found that patients with isolated posterior inferior cerebellar artery (PICA) territory infarct had vertigo, dizziness, and dysmetria.<sup>12</sup> The same results with PICA area infarct have also been observed in a study by Lee et al.<sup>13</sup> However, none of the patients whose infarcts were located in the vicinity of multiple cerebellar arteries or the superior cerebellar artery had isolated vertigo.<sup>13</sup> In contrast Landi et al. and Kerber et al. have found that transient ischemic attack cannot cause vertigo and concluded that "isolated vertigo strongly predicts non-cerebellar events". The limitation of these studies was the use of clinical data to diagnose

infarction; neuro-imaging was not included in the diagnosing protocol.<sup>14,15</sup> In a recent study, Ye et al. showed that the most common symptom in patients with isolated cerebellar infarctions is vertigo (87%).<sup>16</sup>

In the current study, we have found that DM may predict cerebellar infarction in patients with isolated vertigo. In a study by Landi that used clinical data, a significant relationship was only noted between age and ischemic infarction.<sup>14</sup> According to Kerber et al., the incidence of stroke increased slightly in older people.<sup>15</sup> However, both studies were not fully based on imaging data, such as MRI.

In the recent years tremendous attention has focused on the MRI, particularly the sequence of DWI in identifying questionable stroke cases.<sup>17</sup> DWI is designed to detect the random movements of water protons, therefore the brain parenchyma and CSF become hypo-intense and darker in diffusion-weighted images. Acute ischemia induces a shift of water from the unconstrained extracellular space to the more constrained intracellular space (cytotoxic edema).<sup>18</sup> DWI has high sensitivity (98.9%) and specificity (97.6%) in diagnosing acute cerebral infarction.<sup>13</sup>

DWI is expensive and time consuming; however, it is necessary for those patients with a higher probability of brain infarction. According to previous researches, immediate neuro-imaging studies are recommended in older patients presenting with acute sustained vertigo, who have vascular risk factors, new severe headaches, and whose examinations are not completely typical for peripheral vestibulopathy.<sup>19-20</sup> In the current study, only a significant relationship is noted between DM and brain infarction in patients with isolated vertigo. So, it may be helpful to perform DWI in Diabetic patients present isolated vertigo, although further studies with larger sample size and multicenter studies with a higher level of evidence should be performed.

Studies comparing CT, DWI, and standard MRI have found abnormal DWI to be a sensitive and specific indicator of ischemic stroke.<sup>21-23</sup> However, occasional patients with acute ischemic deficits have a normal DWI, but follow-up MRI or CT confirm an infarct. In some of these patients, the infarct was a small brainstem lacune.<sup>24</sup> A false-negative DWI study is not uncommon during the first 24 hours of ischemic stroke. Thus, vertebrobasilar stroke should not be ruled out on the basis of early negative DWI, especially when symptoms persist and are suggestive of this diagnosis.<sup>25</sup> In a study by Bertrand et al., they have compared standard, optimized DWI in 36 consecutive patients with Transient Ischemic attacks (TIA). Optimized DWI was positive in more patients than standard DWI (19 versus 16;  $P < 0.001$ ) and showed more lesions (56 versus 42;  $P = 0.002$ ). Therefore, optimizing DWI has been shown to decrease the rate of false-negative DWI in patients with TIA.<sup>26</sup> In conclusion, the current results indicate that DM could be a possible predictor for infarction in patients with isolated vertigo. Predictive parameters for infarction, including our findings in isolated vertigo, need additional research.

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