

PAPER

Magnetic resonance brain imaging in people with dizziness: a comparison with non-dizzy people

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Background: Dizziness is a common symptom affecting about 30% of people over the age of 65.

Objective: To investigate the hypothesis that structural abnormalities of the brain and cervical cord are more common in dizzy than in non-dizzy subjects.

Methods: A case-control study of subjects over the age of 65 with and without dizziness: 125 dizzy subjects and 86 non-dizzy subjects were recruited from the community through articles in the local press. Magnetic resonance imaging (MRI) of the brain and neck was performed, and was read by a consultant neuroradiologist blind to the clinical details.

Results: All dizzy subjects and all controls had at least one structural abnormality. Cerebral atrophy was found in 86% of dizzy subjects and 85% controls ($p = 1.0$). At least one white matter lesion was found in 69% of dizzy subjects and 78% controls ($p = 0.21$). White matter lesions in the midbrain were more common in dizzy than in non-dizzy subjects (22% v 4%, $p < 0.001$). There were no significant differences in the prevalence of cord compression, cervical spondylosis, facet joint degeneration, vertebral artery compression, or vertebral artery occlusion between dizzy and non-dizzy subjects.

Conclusions: Structural abnormalities of the brain and neck are common in both dizzy and non-dizzy subjects. "Routine" MRI is unlikely to reveal a specific cause for dizziness. The observation of more frequent white matter lesions in the midbrain in dizzy subjects requires further study to determine whether small vessel changes could cause dizziness in older people.

Dizziness is a common symptom which affects about 30% of people over the age of 65.^{1,2} Older people often find it difficult to articulate the nature of their symptoms, but "dizziness" includes sensations such as giddiness, faintness, "light headedness", vertigo, and imbalance. It is associated with depressive symptoms, poor self rated health, falls, and a reduction in social activities.³ We have previously shown that the most common clinical causes of dizziness in older people in the community are central vascular disease (defined as unsteadiness with or without light headedness in association with an abnormal gait, *marche a petits pas*)⁴ or cervical spondylosis (defined as symptoms of dizziness on head or neck movement with reduced range of neck movements).⁵ Thus it is reasonable to suggest that dizziness may be caused by structural problems in the brain or cervical spine. For example, a feeling of unsteadiness may be related to disease of the cerebellum and its connections; vertigo may be related to disease of the cerebellum, its connections, or the VIII nerve; and light headedness may be caused by changes in cerebral blood flow, which may over a long period of time induce structural abnormalities such as white matter lesions.

The presence of structural abnormalities on brain imaging in people with dizziness has not been widely studied. In a study of 79 patients aged between 19 and 59 with rotatory vertigo or "some other manifestation of dizziness" it was found that 34% had at least one abnormality on computed tomography or magnetic resonance brain imaging which was thought to be relevant to the aetiology of dizziness—for example, atrophy, infarction, or demyelination.⁶ In another study of 21 elderly patients with dizziness, ischaemic changes on magnetic resonance imaging (MRI) were present in six of the eight patients who underwent imaging.⁷ Findings such as these have led to the suggestion that brain imaging might be useful in elucidating the cause of dizziness.⁶ However, such abnormalities on structural brain imaging are also common in people without dizziness,^{8,9} and a small study of 20 elderly subjects with dizziness and nine non-dizzy subjects found no difference in the prevalence of white

matter lesions between the two groups (although the lack of association may simply reflect the small numbers of people recruited to the study).¹⁰ There is, however, some evidence that structural brain lesions (for example cerebral atrophy and white matter lesions) are more common in people who complain of disequilibrium, poor balance, and falls (as opposed to the rather more non-specific complaint of "dizziness") than in those without these symptoms.^{11,12}

We have briefly reported preliminary results from MRI of the brain and cervical cord in the dizzy and non-dizzy subjects recruited to our community based study.⁵ We now report our radiological findings in full.

METHODS

Subjects over the age of 65 were invited to take part in the study through articles in the local press and through our local survey of dizziness.² We obtained signed consent and permission from each person's general practitioner before formal recruitment. Only those who had suffered from dizziness for three months or more were recruited to the dizzy group, and only those who had never been dizzy were recruited to the control group. No other inclusion or exclusion criteria were applied, and the dizzy subjects were not matched for age and other clinical characteristics with the non-dizzy subjects. The definition of dizziness included unsteadiness, vertigo or "light headedness", or a combination of these symptoms.

We recorded dizzy symptoms, medical history, current treatments, and functional ability. One of us (NC) performed all the clinical assessments, which included visual acuity testing. Posturography and vestibular testing were also performed, and these results were reported in a previous paper.⁵ The assessments were done blind to the MRI.

MRI of the head and neck was done with a Siemens 1.5 Tesla scanner. Subjects with cardiac pacemakers, intraocular metallic foreign bodies, or intracranial ferromagnetic clips did not undergo scanning. Images were reported according to a

standardised format by a consultant neuroradiologist (RJS) who was blind to whether or not the scans were of a dizzy or non-dizzy subject. Cerebral atrophy was categorised subjectively as mild, moderate, or severe; white matter lesions were defined as an abnormal signal less than 3 mm in diameter (not perivascular); and cerebral infarcts were areas of high signal intensity on T2 images, typically involving the grey and white matter without mass effect. Cord compression was categorised subjectively as mild or severe; subluxation as none, 0–1 cm, or more than 1 cm; facet joint degeneration subjectively as none, mild, moderate, or severe; and vertebral artery compression subjectively as mild, moderate, or severe. Vertebral artery occlusion was identified by a flow void in the appropriate place.

Statistics

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS). We used χ^2 tests, Fisher's exact test, and the Mantel–Haenszel test as appropriate to compare MRI abnormalities in the dizzy and non-dizzy subjects.

RESULTS

We recruited 149 subjects with dizziness and 97 controls. The mean (SD) age of the dizzy subjects was 76 (6) years and 69 (49%) were men. The mean age of the controls was 76 (5) years and 39 (40%) were men. A history of smoking, ischaemic heart disease, stroke, ear disease, and eye disease was significantly more common in dizzy subjects than the controls.⁵ Dizzy subjects were more likely to be taking diuretics, calcium antagonists, and aspirin.⁵ One hundred and sixteen dizzy subjects (77%) described their symptoms as unsteadiness, 89 (60%) as light headedness, and 37 (32%) as vertigo, while 83 (56%) described more than one sensation. Based on standard diagnostic criteria, the most common diagnoses in the dizzy group were central vascular disease (105; 70%),⁴ cervical spondylosis (98; 66%), and anxiety or hyperventilation (48; 32%).⁵ There was considerable overlap of symptoms, with 126 (85%) having more than one diagnosis.³

One hundred and twenty five dizzy subjects and 86 non-dizzy subjects underwent MRI. In the remainder, scanning was contraindicated, refused, or not tolerated.

The main findings were as follows. All dizzy subjects and all controls had at least one structural abnormality. Some degree of cerebral atrophy was found in more than three quarters of dizzy and non-dizzy subjects (table 1). Most subjects, both dizzy and non-dizzy, had at least one white matter lesion (table 2) and the proportions with more extensive hemispheric white matter lesions were very similar in the two groups. Midbrain white matter lesions (but not pons or brain stem lesions) were significantly more common in dizzy subjects (table 2). There was no significant difference in the prevalence of disease of the cervical cord and vertebrae in the dizzy and non-dizzy subjects (table 3), or in the presence of disease of the VIII nerve and semicircular canals (table 4).

DISCUSSION

To our knowledge, this is the largest case–control study of dizzy and non-dizzy people to undergo MRI of their brain and neck. We found no significant differences in the prevalence of cerebral atrophy, the number of white matter lesions, the number of cerebral infarcts, or disease of the semicircular canals or cerebello-pontine angle in subjects with and without dizziness, though dizzy subjects were more likely to have cardiovascular risk factors and a history of previous stroke. This suggests that routine MRI in patients with dizziness is unlikely to be helpful, and does not support the view that “head CT and MRI are diagnostically useful when dizziness of a CNS aetiology is suspected,” as previously suggested.⁶ In older people, dizziness is often attributed to vertebrobasilar ischaemia, which is assumed to be caused by

Table 1 Cerebral hemispheres in dizzy and non-dizzy subjects

	Dizzy subjects (n=125)	Non-dizzy subjects (n=86)	p Value
<i>Atrophy</i>			0.47*
None	17 (14)	12 (15)	
Mild	38 (31)	28 (34)	
Moderate	51 (42)	35 (43)	
Severe	16 (13)	7 (8)	
‡No information	3	4	
<i>White matter lesion</i>			0.21†
0	38 (31)	18 (22)	
1–5	40 (33)	32 (39)	
6–10	21 (17)	15 (18)	
>10	24 (20)	17 (21)	
‡No information	2	4	
<i>Infarct</i>			0.70*
None	118 (96)	80 (98)	
Occipital	0 (0)	2 (2)	
Parietal	0 (0)	0 (0)	
Middle cerebral artery territory	1 (1)	0 (0)	
Lacunar	3 (2)	0 (0)	
Occipital and parietal	1 (1)	0 (0)	
‡No information	2	4	

Values are n (%). The denominator used to calculate the percentage is the number of scans where information is available.

*Mantel–Haenszel test for linear association; † χ^2 test or Fisher's exact test as appropriate (some abnormality v no abnormality).

‡Scans unclear or unreadable.

Table 2 Site of posterior fossa white matter lesions in dizzy and non-dizzy subjects

	Dizzy subjects (n=125)	Non-dizzy subjects (n=86)	p Value (χ^2 test)
Lesion in pons	16 (13)	10 (13)	1.00
No lesion in pons	103 (87)	69 (87)	
Lesion in midbrain	26 (22)	3 (4)	<0.001
No lesion in midbrain	93 (78)	76 (96)	
Lesion in medulla	8 (7)	5 (6)	1.00
No lesion in medulla	111 (93)	74 (94)	
*No information	6	7	

Values are n (%). The denominator used to calculate the percentage is the number of scans where information is available.

*Scans unclear or unreadable.

impaired blood flow through the vertebral arteries as a result of cervical spine disease. We found no difference in disease of the cervical cord and vertebrae in dizzy and non-dizzy subjects. Hence a diagnosis of ‘vertebrobasilar ischaemia’ in dizzy people is probably unhelpful, and the application of such a label may prevent physicians from considering other potential causes of dizziness.

The only difference in MRI between dizzy and non-dizzy subjects was that midbrain white matter lesions were more common in the dizzy subjects. There are several possible explanations for this finding. First, it may be a chance finding, but the p value of < 0.001 makes this highly unlikely. Second, it may be related to the higher prevalence of cardiovascular risk factors in the dizzy group, but if this were the case, one might expect dizzy subjects to have more white matter lesions in all sites (and not just in the midbrain). Third, it is possible that these lesions *cause* dizziness in some patients. Midbrain lesions such as infarcts typically cause eye movement problems.¹³ Although our subjects did not have eye movement

Table 3 Results of magnetic resonance imaging of the cervical cord and vertebrae in dizzy and non-dizzy subjects

	Dizzy group (n=125)	Non-dizzy group (n=86)	p Value
Cord compression			0.81*
None	53 (44)	38 (45)	
Mild	58 (49)	38 (45)	
Severe	8 (7)	8 (10)	
‡No information	6	2	
Subluxation			0.51†
None	113 (95)	77 (92)	
0–1 cm	6 (5)	7 (8)	
>1 cm	0 (0)	0 (0)	
‡No information	6	2	
Facet joint degeneration			0.16*
None	32 (27)	27 (32)	
Mild	31 (26)	25 (30)	
Moderate	32 (27)	21 (25)	
Severe	24 (20)	11 (13)	
‡No information	6	2	
Vertebral artery compression			0.16†
None	63 (53)	53 (64)	
Right	15 (13)	7 (8)	
Left	14 (12)	7 (8)	
Bilateral	27 (23)	16 (19)	
‡No information	6	3	
Vertebral artery occlusion			1.0†
None	90 (76)	63 (76)	
Right	17 (14)	6 (7)	
Left	8 (7)	12 (15)	
Bilateral	4 (3)	2 (2)	
‡No information	6	3	

Values are n (%). The denominator used to calculate the percentage is the number of scans where information is available.

*Mantel-Haenszel test for linear association; † χ^2 square test (some abnormality v no abnormality).

‡Scans unclear or unreadable.

Table 4 Abnormalities of the VIII nerve and semicircular canals

	Dizzy subjects (n=125)	Non-dizzy subjects (n=86)
Acoustic neuroma		
Yes	0 (0)	0 (0)
No	123 (100)	82 (100)
*No information	2	4
Other		
None	118 (96)	79 (96)
Cerebellar atrophy	1 (1)	0 (0)
Abnormal mastoid	3 (2)	2 (2)
Vascular loop around L VII and VIII	0 (0)	1 (1)
High jugular bulb behind IAM	1 (1)	0 (0)
*No information	2	4

Frequencies are too low in some cells for valid statistical tests. IAM, internal auditory meatus.

problems, it is plausible that the clinical effect of infarcts may be different from insidious white matter lesions.¹³ Hence the clinical significance of these midbrain lesions remains uncertain.

We identified our subjects and controls from articles in the local press. Hence, our subjects may have had milder dizziness than people who seek medical attention for this symptom. Had we performed MRI in patients who present to their doctor with dizziness or who were admitted to hospital with

dizziness—that is, the more severe end of the dizzy spectrum—we may have found a higher prevalence of structural brain abnormalities in the dizzy subjects, although one would not necessarily be able to attribute a causative role to such abnormalities. Had we just recruited patients with poor balance or falls, as in two previous studies,^{11,12} we might have found a higher prevalence of structural abnormalities. However, we were interested in the complaint of dizziness in general rather than in more specific symptoms such as vertigo. Over half the patients with dizziness complained of more than one symptom, which meant that it was not possible to compare the MRI findings in patients with unsteadiness, vertigo, or light headedness.

Implications

These data suggest that routine MRI in the investigation of dizziness is unhelpful, because most abnormalities (for example, cerebral atrophy and white matter lesions) are equally common in people with and without dizziness. Obviously, if a specific diagnosis such as an acoustic neuroma is suspected, then MRI should be performed. The observation of more frequent white matter lesions in the midbrain in dizzy subjects requires further study to determine whether small vessel changes could cause dizziness in older people. Studies to determine the relation between falls, poor balance, and structural brain lesions would be interesting.

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