



## ARAŞTIRMA/RESEARCH

### Utility of 1.5 tesla magnetic resonance imaging brain study in evaluating giddiness: a retrospective study of 500 cases

Baş dönmesinin değerlendirilmesinde 1.5 teslalık manyetik rezonans görüntüleme beyin çalışmasının yararlılığı: geriye dönük 500 olguluk bir çalışma

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#### Abstract

**Purpose:** The purpose of this study was to evaluate the utility of 1.5 tesla magnetic resonance imaging (MRI) brain studies in evaluating the cause of giddiness.

**Materials and methods:** In this retrospective analytical study; MRI brain scans of 500 patients who presented with giddiness; were analysed to assess if the cause of giddiness could be found in them.

**Results:** Five-hundred MRI serial scans were reviewed. Gender wise total 288 females and 212 males with age ranging between 36 to 74 years were found. Two hundred and seventy two scans (54.4%) were reported as completely normal. Significant findings were seen in 52 cases (10.4%); when mastoiditis was not taken into account. When mastoiditis was included as a possible cause of giddiness, the significant findings were seen in 284 cases (56.8%) of cases. The most frequent incidental finding were cerebral atrophy in 177 cases (35.4 %), old infarcts in 144 scans (28.8%) and ischemic foci in 136 scans (27.2%). Seventy seven scans (13.5%), had clinically serious incidental findings that needed further management.

**Conclusion:** High sensitivity and specificity of the MRI mentioned in other studies justifies its use in investigating patients with giddiness that do not respond to routine medications. MRI scans in such patients can successfully demonstrate the significant findings - which can directly cause giddiness. But incidence of such findings is very less. Most often, incidental findings are demonstrated which may or may not be clinical significance. MRI being a costly investigation, should therefore be used judiciously in such patients.

**Key words:** Brain, dizziness, magnetic resonance imaging.

#### Öz

**Amaç:** Bu çalışmanın amacı baş dönmesi sebeplerinin değerlendirilmesinde 1.5 tesla manyetik rezonans beyin görüntüleme çalışmasının faydasını değerlendirmektir.

**Gereç ve Yöntem:** Geçmişe yönelik bu analitik çalışmada baş dönmesi görülen 500 hastanın MRG beyin taramaları baş dönmesi sebeplerini belirleyebilmek için analiz edildi.

**Bulgular:** 500 MRG seri taramaları incelendi. Cinsiyet bilgisi yaşları 36 ile 74 arasında değişen 288 kadın ve 212 erkek olarak belirlendi. 272 tarama (%54.4) tamamen normal olarak bildirildi. Mastoiditlerin göz önünde bulundurulmadığı 52 vakada (%10.4) önemli bulgular görüldü. Mastoidit baş dönmesinin olası sebebi kabul edildiğinde önemli bulgular 284 vakada, yani vakaların %56.8'inde görülmektedir. En sık rastlanan tesadüfi bulgular; 136 taramada (%27.2) iskemik odaklar, 144 taramada (%28.8) eski infarktüsler, 177 olguda (%35.4) görülen serebral atrofilerdir. 77 taramada ise (%13.5) ileri değerlendirmeye ihtiyaç duyulan klinik olarak ciddi rastlantısal bulgular saptanmıştır.

**Sonuç:** Diğer çalışmalarda bahsedilen MRG'nin yüksek duyarlılık ve özgüllük; rutin ilaç tedavisine yanıt vermeyen baş dönmesi olan hastaların incelenmesinde kullanılmasını doğrulamaktadır. Bu hastalarda MRG taraması direkt olarak baş dönmesine sebep olan önemli bulguları başarıyla gösterebilmektedir. Fakat bu bulguların sıklığı oldukça azdır. Çoğu zaman klinik açıdan önemli olabilen veya klinik açıdan önemli olmayan rastlantısal bulgular gösterilebilir. Maliyetli bir inceleme olan MRG bu özelliği nedeniyle böylesi hastalarda sağduyulu bir şekilde kullanılmalıdır.

**Anahtar kelimeler:** Beyin, baş dönmesi, manyetik rezonans görüntüleme.

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## INTRODUCTION

Giddiness is a non-specific symptom or feeling that is a common presenting complaint. It is scientifically expressed as dizziness which means impairment in spatial perception and stability as defined in **Dorland's Medical Dictionary**. Giddiness or dizziness is reported in about 20–30% of the population at some point in the previous year<sup>1</sup>. As multiple parts of the body are required for maintaining balance including the inner ear, eyes, muscles, skeleton, and the nervous system, any disorder or disease in these systems can manifest as what is commonly referred to as Giddiness<sup>2</sup>. Common physiological causes of giddiness include inadequate blood supply to the brain due to a sudden fall in blood pressure or heart problems or arterial blockages, loss or distortion of vision or visual cues, disorders of the inner ear distortion of brain/nervous function by medications such as anticonvulsants and sedatives<sup>2</sup>. Differential diagnoses of many conditions are associated with dizziness. However, the most common subcategories can be broken down as follows: 40% peripheral vestibular dysfunction, 10% central nervous system lesion, 15% psychiatric disorder, 25% presyncope / dysequilibrium, and 10% nonspecific dizziness<sup>3</sup>.

The medical conditions that often have giddiness as a symptom include: benign paroxysmal positional vertigo, meniere's disease, vestibular neuronitis labyrinthitis, otitis media, brain tumor, acoustic neuroma, chronic motion sickness, Ramsay Hunt syndrome, migraine, multiple sclerosis, pregnancy low blood pressure (hypotension), low blood oxygen content (hypoxemia) heart attack, iron deficiency (anemia), low blood sugar (hypoglycemia), hormonal changes (e.g., thyroid disease, menstruation, pregnancy), panic disorder, hyperventilation, anxiety, depression, age-diminished visual, balance, and perception of spatial orientation abilities<sup>1-3</sup>.

Giddiness is a common presenting symptom in medicine as well as otorhinolaryngology outpatient departments. When the symptom is persistent even after medications, patients are invariably referred for magnetic resonance imaging studies (MRI) of Brain. But how useful are MRI studies in disclosing the exact cause of giddiness? Well, some studies have reported a very high percent of incidental findings and a very low percent of significant findings [4-8]. No such studies have been carried out in our setup.

Hence, this study was undertaken. The aims of this study were; to record the incidental findings in patients who underwent MRI brain for giddiness as the presenting symptom, to record the significant findings in patients who underwent MRI brain for giddiness as the presenting symptom, to classify patients of giddiness depending upon MRI findings and to analyze the importance of MRI findings in clinical management.

## MATERIAL AND METHODS

This was a retrospective cross sectional (observational) study. MRI reports of 500 patients who underwent MRI brain for giddiness as the presenting symptom were studied for the presence of incidental findings as well as significant findings, so as to analyze the importance of such findings in our setup.

Request for waiver of consent from the subject whose MRI report was used in this retrospective study was applied for and obtained from the IEC as there won't be any direct contact with patient in this study. IEC approval is numbered PMT/RMC/ICMR/ 2015/ 30 dated 21/01/2015. Registration No: PIMS/ ICMR/Research/2015/14. The identity of patient generated in the study was bounded in strict confidence. The data was available only to the investigator involved in the study and to the regulatory authorities. Break in the confidentiality was never done.

## RESULTS

Five-hundred MRI serial scans were reviewed. Gender wise total 288 females and 212 males with age ranging between 36 to 74 years were found. Two hundred and seventy two scans (54.4%) were reported as completely normal (Table 1). Significant findings were seen in 52 cases (10.4%) when mastoiditis was not taken into account. When mastoiditis was included as a possible cause of giddiness, the significant findings were seen in 284 cases (56.8%) of cases. The number is more as many cases had common findings i.e. mastoiditis as well as the other significant findings. Mastoiditis was seen in 46.4%, Cholesterol granuloma in 1.4%, Epidermoid cyst in 1.6 %, Arachnoid cyst in 3.4%, Schwannoma 2.4% and apical petrositis in 1.6 % cases. Seven hundred and sixty two incidental findings were found in the 500 scans that were

retrospectively analysed. The most frequent incidental finding were cerebral atrophy in 177 cases (35.4 %), old infarcts in 144 scans (28.8%) and ischemic foci in 136 scans (27.2%). Here also an overlap of findings in same scan was noted in many instances.

Seventy seven scans (13.5%), had clinically serious incidental findings that needed further management.

Glioma was seen in 14 scans (2.8%), pituitary macroadenoma was seen in 9 scans (1.8%), cavernous angioma was seen in 3 scans (0.6%), contusion was noted in 12 scans (2.4%), tuberculoma in 18 scans (3.6%), mesial temporal sclerosis in 7 (1.4%), sub arachnoid bleed in 5 scans (1.0%), intra parenchymal bleed in 8 scans (1.6%), meningioma in 7 scans (1.4%) and metastases in 8 scans (1.6%).

**Table 1. Spectrum of findings in MRI scans of patients with giddiness**

Sr. No	MRI Finding	Number of Cases (%)	Significant / Incidental
1	Normal Study	272 ( 54.4)	-----
2	Ischemic Foci	136 ( 27.2)	Incidental
3	Acute Infarct	42 ( 8.4)	Incidental
4	Old Infarct	144 ( 28.8)	Incidental
5	Atrophy	177 ( 35.4)	Incidental
6	Mastoiditis	232 ( 46.4)	Significant
7	Sinusitis	154 ( 30.8)	Incidental
8	Cholesterol Granuloma	07 ( 1.4)	Significant
9	Progressive Multifocal Leucoencephalopathy	01 ( 0.2)	Incidental
10	Glioma	14 ( 2.8)	Incidental
11	Epidermoid	08 ( 1.6)	Significant
12	Arachnoid Cyst	17 ( 3.4)	Significant
13	Pituitary Macro adenoma	09 ( 1.8)	Incidental
14	Cavernous Angioma	03 ( 0.6)	Incidental
15	Contusion	12 ( 2.4)	Incidental
16	Tuberculoma	18 ( 3.6)	Incidental
17	Calcified Granuloma	06 ( 1.2)	Incidental
18	Mesial Temporal Sclerosis	07 ( 1.4)	Incidental
19	Sub Arachnoid Bleed	05 ( 1.0)	Incidental
20	Intra parenchymal Bleed	08 ( 1.6)	Incidental
21	Neuroglial Cyst	03 ( 0.6)	Incidental
22	Choroid plexus cyst	04 ( 0.8)	Incidental
23	Demyelinating Disorders	04 ( 0.8)	Incidental
24	Schwannoma	12 ( 2.4)	Significant
25	Metastases	08 ( 1.6)	Incidental
26	Meningioma	07 ( 1.4)	Incidental
27	Apical Petrositis	08 ( 1.6)	Significant

## DISCUSSION

Giddiness is a non-specific symptom or feeling that is a common presenting complaint. It is scientifically expressed as dizziness which means an impairment in spatial perception and stability as defined in **Dorland's Medical Dictionary**. When patients with complaints of giddiness visit a doctor , they are given a thorough clinical examination and put on medications to start with. If the symptoms persist or are very severe, MRI scans of such patients is ordered to look for the cerebrum and cerebellum as

well as for cerebello-pontine angle lesions and the internal auditory meatus.

In 1993, Robson et al. used MRI as a single screening procedure for acoustic neuroma and in patients with giddiness<sup>9</sup>. They found it to be a cost effective protocol. Way back in 1997 Raber et al. studied the utility of MRI toward cost-effective diagnosis of patients with asymmetric hearing loss and giddiness<sup>10</sup>. They found MRI to be cost effective in such patients. In 2004 Kwan et al. performed an analysis of 1821 patients that were screening for vestibular schwannoma by MRI<sup>11</sup>.

Giddiness was a common complaint in these patients. This study too concluded that MRI is effective in such patients. But it was a concern for all researchers that when MRI is advised in patients with giddiness, very few MRI scans show the direct etiology. In addition, most of these scans showed findings that were totally unexpected, some of which had clinical significance; while others were purely incidental. Therefore in 2006 a working group on incidental findings in brain imaging research was constituted, comprising of researchers like Illes J, Kirschen MP, Edwards E, Stanford LR, Bandettini P, Cho MK, Ford PJ, Glover GH, Kulynych J, Macklin R, Michael DB, Wolf SM. Their findings were published as "Ethics: incidental findings in brain imaging research"<sup>12</sup>.

In 2007 Meike et al published their report on the incidental findings on brain MRI in the general population<sup>8</sup>. The report reiterated that such findings are quite common. In 2009 Fortnum et al performed a systematic review of clinical and cost effectiveness and natural history of patients with acoustic neuroma having giddiness as the common presenting complaint<sup>13</sup>. They concluded that Auditory Brainstem Testing is non effective and expensive for screening such patients. On the contrary, MRI stood out as the problem solving tool in such cases. Sone et al. performed MRI imaging analysis in cases with inflammation-induced sensorineural hearing loss presenting with giddiness. They found that MRI gave satisfactory results<sup>14</sup>.

Approximately half of the scans (52%) performed were reported to be normal. This is a common finding in reported series of MRI scans performed in order to investigate various audiovestibular symptoms<sup>8,9</sup>. Studies of healthy volunteers or the general population show a higher percentage of normal scans<sup>13,15</sup>. In 2010 Papanikolaou et al. studied Incidental findings on MRI scans of patients presenting with audiovestibular symptoms<sup>15</sup>. They found that although 96 (48%) of the scans demonstrated positive findings, only one scan showed vestibular schwannoma in a patient whose giddiness could be attributed to it. Rest of 95 scans (47.5%) revealed positive findings, but these could not be directly linked to the giddiness and therefore were labeled as incidental findings. Amongst the incidental findings, asymptomatic infarcts in the brain, aneurysms in the cerebrum and various primary benign tumors have been reported quite frequently<sup>8</sup>.

In 2013 Saindane et al. in their study found that in patients with giddiness, the incidental findings of idiopathic intracranial hypertension and "empty sella" may exist. In 2014 Hoekstra Prijs and Zanten evaluated 321 patients of giddiness and found anterior inferior cerebellar artery loops in 70 (23%) patients. They opined that this finding rarely relates to the giddiness and hence should thus be considered as incidental findings. In 2015 Kalsotra et al. studied the incidental findings on magnetic resonance imaging in patients with giddiness by evaluating MRI scans of 62 patients and found vestibular schwannoma in a patient of neurofibromatosis. They found incidental findings in 26 cases (41.93%); out of which 8 cases (12.90%) were of white matter lesions, vascular anomalies accounted for 5 cases (8.66%), arachnoid cyst was seen in 3 cases (4.83%), 2 cases (3.22%) had empty sella, 4 cases (6.45%) showed sinus involvement, only 2 cases (3.22%) had cerebral atrophy and 2 (3.22%) had vascular infarcts. They concluded that these findings were neither serious nor warranted an urgent surgical intervention, but they also emphasized that a few cases required referral to other specialties.

Giddiness is a common presenting symptom. Sometimes, it may respond to medications and many times it doesn't. So it is a general practice that when the symptom is persistent even after medications, patients who can afford; are invariably referred for MRI of brain- in hope of finding the exact cause. MRI studies are costly and time consuming. And, of course there are some contra indications due to the Magnet involved. Hence, it is important to find out how useful are MRI studies in disclosing the exact cause of Giddiness? Patient demography and the variety of incidental findings and significant findings would add to our knowledge on this topic as no such studies have been carried out in our setup. This would also enable the researcher to gain immense knowledge and add to the scientific pool of this institute. Hence the present study was proposed.

This retrospective study included 500 serial scans of patients who presented with giddiness. The findings are as follows:

1. **Normal findings:** Approximately half of the scans (54.4%) were reported as completely normal. This is in agreement with study by Papanikolaou et al<sup>15</sup>, who found the incidence to be 52% in their study and by Kalsotra et al

who reported 54.84% MRI scans as normal<sup>18</sup>. Normal MRI study has also been reported by other researchers who investigated patients of giddiness<sup>9-12</sup>. More over MRI scans in general population demonstrated a higher percentage of normal scans<sup>5,7</sup>.

2. **Positive findings:** In the present study, positive findings were seen in 56.8%, out of which significant findings were seen in 10.4%. In the study by Papanikolaou V, Khan M and Keogh I et al<sup>15</sup>, 48% of the scans demonstrated positive findings out of which only one ipsilateral vestibular schwannoma was detected in a patient with tinnitus. In their study 47.5% scans revealed positive findings, not be directly attributable to giddiness and therefore considered as incidental findings. This percentage was 46.4 in the present study. Kalsotra P et al<sup>18</sup> found positive findings in MRI in 43.12 % out of which significant findings were seen in 3.2% cases and incidental findings in 41.93%.
3. **Spectrum of incidental findings:** In the present study, the most frequent incidental finding were cerebral atrophy in 35.4 % , old infarcts in 28.8% and ischemic foci in 27.2%. Papanikolaou et al reported atrophy in 5.5% cases<sup>15</sup> while Kalsotra et al reported it in 3.22%<sup>18</sup>. Scahill et al. studied changes occurring in brain volumes with age and observed that atrophy occurs with age<sup>19</sup>. Kerber et al. have pointed to the possible association of cerebral atrophy and giddiness<sup>20</sup>. Intracranial calcifications as seen in rare conditions like lipid proteinosis can manifest as giddiness too<sup>21</sup>. Identifications of such findings in fetal stage may help us decide how much weight age one needs to give to them in adult stage if giddiness is of late onset<sup>22</sup>. A high occurrence of incidental findings like asymptomatic brain infarcts, cerebral aneurysms and benign primary tumors being has been reported in other study as well<sup>8</sup>. Mirza et al reported a frequency of 41% of incidental findings that included

vascular anomalies, tiny infarcts, cerebral atrophy, sinus findings and mastoiditis most commonly<sup>4</sup>. Presence of subcortical white matter hyper intensive foci, commonly referred as WML, has been reported in 44% cases by Papanikolaou et al<sup>15</sup>. Kalsotra et al found incidental findings in 26 cases (41.93%); out of which 8 cases (12.90%) were of white matter lesions, vascular anomalies accounted for 5 cases (8.66%), arachnoid cyst was seen in 3 cases (4.83%), 2 cases (3.22%) had empty sella, 4 cases (6.45%) showed sinus involvement, only 2 cases (3.22%) had cerebral atrophy and 2 (3.22%) had vascular infarcts<sup>18</sup>.

4. **Spectrum of Significant Findings:** In the present study, spectrum of significant findings that could explain giddiness included mastoiditis (46.4%), arachnoid cyst (3.4%), schwannoma (2.4%), epidermoid cyst (1.6 %), apical petrositis (1.6 %) and cholesterol granuloma (1.4%), Meningioma (1.4%). Representative images are shown in Figure 3 to Figure 6. In study by Papanikolaou V et al<sup>15</sup> meningioma was seen in 0.5% and 0.9% in study by Meike et al.<sup>8</sup>

In the present study 30.8% had findings related to paranasal sinuses while they were seen in 6% in study by Papanikolaou V et al<sup>15</sup> and 6.45% showed sinus involvement in study by Kalsotra et al<sup>18</sup>. In the present study, when mastoiditis was included as a possible cause of giddiness, the significant findings were seen in 284 cases (56.8%) of cases. The number is more as many cases had common findings i.e. mastoiditis as well as the other significant findings. Mastoiditis was seen in 46.4%. Papanikolaou et al reported this in 3% cases<sup>15</sup>.

Limitation of this study is its observational and retrospective nature. No attempt was therefore made to compare with gold standard like histopathological reports of lesion. Hence, sensitivity and specificity of MRI as well as ROC curves could not be obtained. the authors plan to do a prospective larger study in near future.

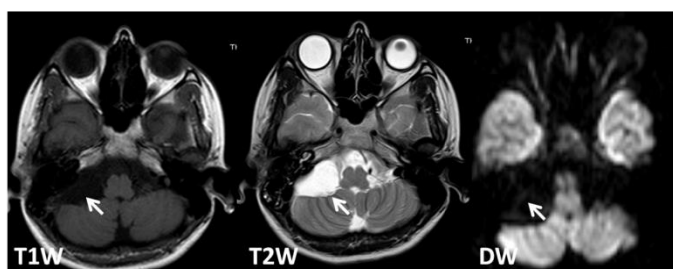


Figure 1. Rt CP angle arachnoid cyst



Figure 2. Lt CP angle Epidermoid Cyst



Figure 3. rt CP angle Meningioma

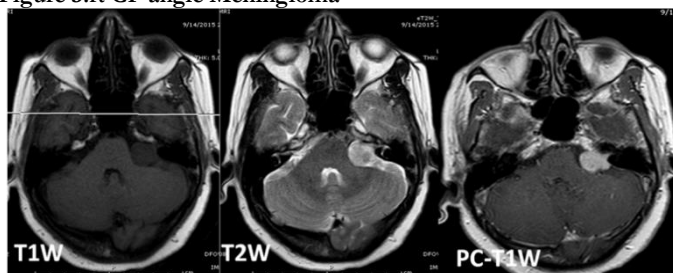


Figure 4. Lt CP angle Schwannoma

High sensitivity and specificity of the MRI as found in other studied justifies its use in investigating patients with giddiness that do not respond to routine medications. MRI scans in such patients can successfully demonstrate the significant findings-which can directly cause giddiness. But incidence of such findings is very less. Most often, incidental findings are demonstrated which may or may not be clinical significance. MRI being a costly investigation, should therefore be used judiciously in such patients.

The study emphasizes the fact that it is the responsibility of the referring doctor to weigh the clinical significance of the various findings reported on MRI scan of such patients, discuss their relevance with the patients, and only then refer them for further appropriate management, if needed.

Persistent giddiness is a cause of concern for many people. When medications fail to alleviate the symptoms, MRI scan of such patients is ordered to look for possible treatable definitive cause.

The present study retrospectively evaluates the MRI findings in 500 such patients. The study successfully compiles the patient demography and the variety of incidental findings and significant findings and therefore adds to our knowledge on this topic as no such studies have been carried out in our setup. The study recognizes the fact that sinus findings in various MRI series performed for non-sinonasal complaints appear to be quite common and that an overlap of combinations of various such incidental as well as significant findings can be seen in such cases. Thus this study provides new knowledge and adds to the scientific pool on this topic of research.

Based on the current research, it can be stated that 1.5 T MRI has definite utility in evaluating giddiness as it can- Not only successfully demonstrate the significant findings- which can directly cause giddiness; but also show the associated incidental findings which may or may not be clinically significant. The study reiterates that it is the responsibility of the referring doctor to weigh the findings reported on MRI scan in the light of clinical significance and then adequately discuss their relevance with the patients in order to reach consensus for appropriate management to alleviate their giddiness.

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