

Original Research Article

Role of MRI Versus CT Scan in Evaluation of Patient with Vertigo

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Abstract

Vertigo is a sensation of motion when no motion . It caused by central and peripheral causes, central causes of vertigo can be life threatening when associated with stroke. The radiological imaging for evaluation patients with vertigo are CT scan and MRI. understanding the ability of MRI compared with CT scan in detection of pathological cause of vertigo would be helpful in determining the optimal imaging modality in patient with vertigo. 100 patients with vertigo evaluated by MRI and CT scan . MRI sequences was done is T1 weighted fast field echo FFE, T2 weighted turbo spin echo TSE and fluid attenuation inversion recovery FLAIR. The sections was axial , coronal and sagital. The results was 51(51%) male and 49(49%) female aged between 18-78 years we find that 85(85%) with positive finding in MRI. 43(43%) with positive finding in both MRI and CT scan. 42 (42%) with negative finding in CT scan and positive in MRI. 15 (15%) was negative in both CT scan and MRI. Ischemia was the main finding that detected by MRI and CT scan.. The sensitivity of CT scan was 50.58% for detection central causes of vertigo compared with 83% for MRI. Was MRI play an important role in evaluation of patient with vertigo and has a high ability to detect a central cause of vertigo than CT scan. MRI should be the first imaging modality if the central causes of vertigo are suggested.

Key Words: computerized tomography, MRI, crebellopontine angle, fast field echo, turbo spin echo, fluid attenuation inversion recovery.

دور الرنين المغناطيسي مقابل فحص المفراس في تقييم المرضى الذين يعانون من الدوار

الخلاصة

الدوار هو الشعور بالحركة والدوران عندما لا حركة ولا دوران. سببها أسباب مركزية وطرفية، الأسباب المركزية للدوار يمكن أن تكون مهددة للحياة عندما ترتبط مع الجلطة الدماغية. الجلطة الدماغية الغير مشخصة في مريض يعاني من الدوار لديها معدل وفيات ٤٠٪. أجهزة التصوير لتقييم المرضى الذين يعانون من الدوار هي الأشعة المقطعية والتصوير بالرنين المغناطيسي. استخدام أجهزة ذات حساسية منخفضة في تشخيص أسباب الدوار قد يؤدي إلى طمأنة كاذبة للطبيب المعالج وهذا قد يؤدي إلى ترك المريض مع أسباب غير مشخصة وغير معالجة. معرفة قدرة التصوير بالرنين المغناطيسي مقارنة مع الأشعة المقطعية في الكشف عن السبب المرضي للدوار سيكون مفيدا في تحديد طريقة التصوير الأمثل التي يمكن استخدامها في تقييم مرضى الدوار. (١٠٠) مريض يعانون من الدوار راجعوا مستشفى الحلة التعليمي، تم اخذ التاريخ المرضي لكل واحد منهم. تم إجراء التصوير المقطعي والتصوير بالرنين المغناطيسي لكل منهما إن المقاطع التي أخذت للمرضى كانت مقاطع محورية، إكليلية، وجانبية. وكانت النتائج ٥١ (٥١٪) من الذكور و ٤٩ (٤٩٪) من الإناث الذين تتراوح أعمارهم بين ١٨-٧٨ سنة نجد أن ٨٥ (٨٥٪) كانت نتيجة ايجابية في التصوير بالرنين المغناطيسي. ٤٣ (٤٣٪) كانت نتيجة ايجابية في كل من التصوير بالرنين المغناطيسي والتصوير المقطعي. ٤٢ (٤٢٪) كانت نتائج سلبية في الأشعة المقطعية وايجابية في التصوير بالرنين المغناطيسي. ١٥ (١٥٪) كانت نتائج سلبية في كل من التصوير المقطعي والتصوير بالرنين المغناطيسي. وكانت النتيجة الرئيسية التي كشفت عن طريق التصوير بالرنين المغناطيسي في ٦٢ مريضا وعن طريق الأشعة المقطعية في ٣٠ مريضا هي الجلطة الدماغية. الأشعة المقطعية لم تتمكن من كشف

الجلطة الدماغية في ٣٢ مريضاً والتصلب المتعدد في ١٠ مرضى. وكانت حساسية الأشعة المقطعية ٥٠,٥٨٪ للكشف عن الأسباب المركزية للدوار.

التصوير بالرنين المغناطيسي يلعب دوراً هاماً في تقييم المرضى الذين يعانون من الدوار ولديه قدرة عالية للكشف عن الأسباب المركزية للدوار مقارنةً بالأشعة المقطعية. لذا يجب أن يكون التصوير بالرنين المغناطيسي هو طريقة التصوير الأولى إذا كان هناك احتمالاً للأسباب المركزية للدوار.

الكلمات المفتاحية: الرنين المغناطيسي، التصوير المقطعي، انعكاس الانتعاش وتوهين السوائل، مرجحة توربو تدوير الصدى، مرجحة المجال السريع الصدى.

Introduction

Vertigo is characterized by sensation of spinning or sensation of movement when no movement and its often associated with nausea, vomiting and imbalance [1,2]. The prevalence of vertigo is more than 30% in elderly and 1.8% among young adult, in united states of America 13-38% of patients over 65 years are suffer from vertigo[3]. no sex deference in vertigo incidence, the main age group affected between 18-80 years[3]. A study find that male to female ratio is 1.32: 1 with age group 21-70 years [4]. Vertigo caused by peripheral or central causes, peripheral causes which affect the labyrinths or vestibular nerves .it is the most common and generally benign [2, 5, 6]. Causes of central vertigo which affect the central vestibular pathway can be life threatening when associated with stroke therefore distinguishing central from peripheral vertigo is important [2, 7]. While there is evidence that history and physical examination can help in distinguishing central from peripheral vertigo, many patients refer to neuro imaging when the clinical findings are uncertain [2]. the peripheral causes of vertigo are: acute labyrinthitis, benign paroxysmal vertigo, acute vestibular neuritis, -cholesteatoma, menier"s disease, herpes zoster oticus, perilymphatic fistula, osteosclerosis. The central causes are: cerebrovascular disease, cerebellopontine angle tumor, multiple sclerosis, migraine. Other cause are: cervical vertigo, drug induced, psychological [5, 8]. Imaging play very important role in the assessment of

patient with vertigo, the imaging tools which available for evaluation of patient with vertigo are CT scan, MRI [8]. Using of insensitive low yield imaging modality may result in false reassurance for the physician [6, 8]. Understanding the ability of MRI compared with CT scan in detection of pathological cause in patient with vertigo would be helpful in determining the optimal imaging modality in patient with vertigo[2]

Aim of my study was to explain the role of MRI versus CT scan in evaluation of patient with vertigo by detecting the causes of vertigo in patient with negative or unclear CT scan finding .

Methods and Materials

This research is approved by scientific surgical committee in Babylon university, college of medicine after verbal permission from each patient. The study design was used in our study is (Observational /descriptive /crosssectional study) from December 2016 to august 2017 done on group of 100 patients consulting AL-HILLA teaching hospital suffering from vertigo according to the request paper. All request papers asked for brain CT scan except one asked for petrus bone. History was taken from each patient include name, age, chronic disease (HT, DM), ear disease, previous operations, history of head trauma ,drugs and then referred for CT scan and MRI which is done for each of them . the CT scan used in examination are Philips brilliance 2011 and Siemens somato definition AS ,and the section was taken

is head 0.5 axial section and the MRI used in examination is Philips Achieva 1.5 Tesla 2011.

MRI will be done for these patients in multiple sequences (T1wiegthed fast field echo FFE, T2wiegthed turbo spin-Echo TSE and fluid attenuation inversion recovery FLAIR with axial/ coronal/ sagital sections and gadolinium to determine the positive finding in MRI which is negative or unclear in CT scan.

In this study over eight months one hundred one (101) patients complaining of vertigo were screened one patient excluded due to location of shell at the mandible which prevent MRI examination. The study sample was 100 patients 51 (51%) male and 49 (49%) female with M:F ratio 1.04:1 aged between 18-78 years with mean age 48 year. we find that 60 (60%) patients with positive history of chronic disease and 40 (40%) with negative history 80 (80%) patients presented with associated symptoms with vertigo and 20 (20%) with no associated symptoms (Table-1).

Results

Table 1: Distribution of patients with vertigo according to Sociodemographic Characteristics

Sociodemographic Characteristics		
Age (years)	(49.53 ± 12.67)	(18-78)
Gender		
Male	51	51.0%
Female	49	49.0%
Total	100	100.0%
History of chronic diseases		
Present	60	60.0%
Absent	40	40.0%
Total	100	100.0%
Clinical presentation		
Present	80	80.0%
Absent	20	20.0%
Total	100	100.0%

Distribution of patients with vertigo according to history of chronic disease which consider as risk factor was 63.3% with hypertension, 16.7% with hypertension and diabetes mellitus, 6.7%

with hypertension and ischemic heart disease, 6.7% with diabetes mellitus, 3.3% with ischemic heart disease and 3.3% with hypertension and asthma (Figure 1).

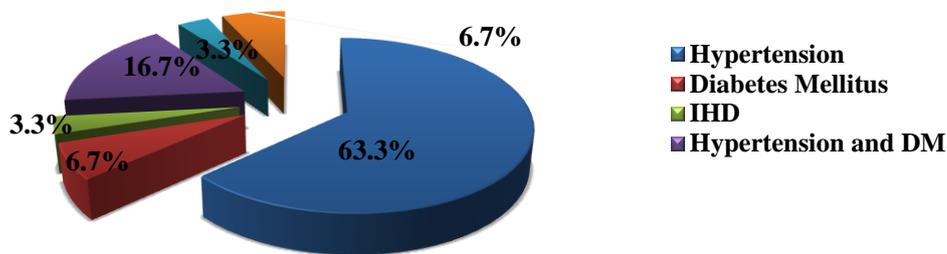


Figure 1: Distribution of patients according to history of chronic diseases

from above figure we find that the main chronic disease associated with vertigo are hypertension and hypertension with diabetes mellitus or ischemic heart disease.

The main associated symptom with vertigo explained in **figure 2**

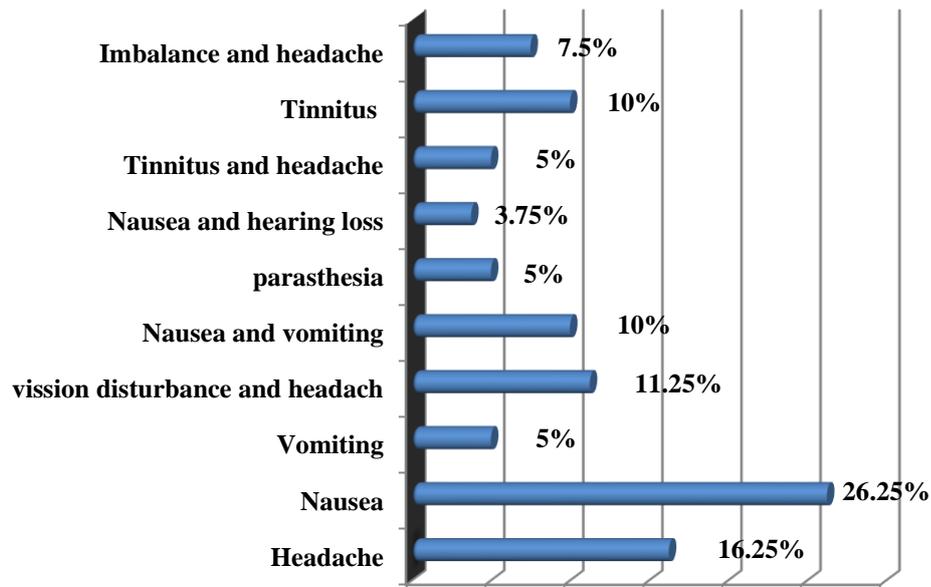


Figure 2: Distribution of patients according to associated symptoms

From figure-2 nausea was the main associated symptoms. The specific neurological symptoms like headache, visual disturbance, imbalance and parasthesia suggest a central cause of vertigo. While other symptoms represent a general presentation of vertigo.

CT scan and MRI was done for each of them, we find that: **85** (85%) patients 47 male and 38 female with positive findings in MRI which distributed as

follow: 62 (72.9%) 37 (78.7%) male and 25 (65.8%) female show ischemia. 10 (11.8%) 4 (8.5%) male and 6 (15.8%) female show multiple sclerosis. 4 (4.7%) 0 (0.0%) male and 4 (10.5%) female show cerebellopontin angle mass. 3 (3.5%) 2 (4.3%) male and 1 (2.6%) female show mastoiditis and otitis media. 5 (5.9%) 3 (6.4%) male and 2 (5.3%) female show sinusitis. 1 (1.2%) 100% male show clivus bone fibrous dysplasia (**table 2**)

Table 2: Distribution of patients with vertigo according to MRI finding and gender.

MRI findings	Male (%)	Female (%)	Total (%)
Ischemia	37 (78.7%)	25 (65.8%)	62 (72.9%)
CPA mass	0 (0.0%)	4 (10.5%)	4 (4.7%)
Mastoiditis and otitis media	2 (4.3%)	1 (2.6%)	3 (3.5%)
Clivus fibrous dysplasia	1 (2.1%)	0 (0.0%)	1 (1.2%)
Sinusitis	3 (6.4%)	2 (5.3%)	5 (5.9%)
Multiple sclerosis	4 (8.5%)	6 (15.8%)	10 (11.8%)
Total	47 (100.0%)	38 (100.0%)	85 (100.0%)

* patients presented with negative results according to MRI.

43 (43%) patients 25 male and 18 female with positive finding in CT scan which distributed as follow: 30 (69.8%) 19

(76.0%) male and 11 (61.1%) female show ischemia. 4 (9.3%) 0 (0.0%) male and 4 (22.2%) female show cerebellopontin

angle mass . 3(7.0%) 2 (8.0%) male and 1 (5.6%) female show mastoiditis with otitis media . 5(11.6%) 3 (12.0%) male and 2(11.1%) female show sinusitis. 1

(2.3%) 1 (4.0%) male and 0(0.0%) female show clivus bone fibrous dysplasia (**table 3**).

Table 3: Distribution of patients with vertigo according to CT finding and gender

CT findings	Male (%)	Female (%)	Total (%)
Ischemia	19 (76.0%)	11 (61.1%)	30 (69.8%)
CPA mass	0 (0.0%)	4 (22.2%)	4 (9.3%)
Mastoiditis and otitis media	2 (8.0%)	1 (5.6%)	3 (7.0%)
Clivus fibrous dysplasia	1 (4.0%)	0 (0.0%)	1 (2.3%)
Sinusitis	3 (12.0%)	2 (11.1%)	5 (11.6%)
Total	25 (100.0%)	18 (100.0)	43(100.0%)

*57 patients presented with negative results according to CT scan

42 (42%) patients with negative finding in CT scan and positive in MRI which distributed as fallow: 32 (76%) 18 (82%) male and 14 (70%) female show

ischemia.10 (24%) 4(18%) male and 6(30%) female show multiple sclerosis (**table 4**).

Table 4:Distribution of patients with negative results in CT scan and positive in MRI

Result	male	female	Total %	%
Ischemia	18 (82%)	14 (70%)	32 (76%)	76%
MS	4 (18%)	6 (30%)	10(24%)	%24
Total	22 100%	100% 20	42	100%

The results was obtained by MRI and CT scan show that MRI detect 62 findings with ischemia compared with 30 finding detected by CT scan, 10 finding with multiple sclerosis detected by MRI and

not detected by CT scan. while cerebello potine angle masses, mastoiditis, otitis media and sinusitis can be detected by CT scan and MRI (**figure 3**).

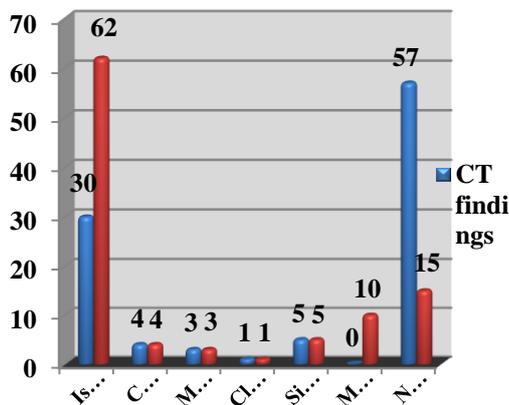


Figure 3: Comparison between CT & MRI findings regarding patients with vertigo according to number of cases.

From figure-3 the negative results in CT scan was very high in CT scan 57(57%) compared with 15(15%) in MRI. the positive finding was mainly detected by

MRI 85 (85%) compared with that detected by CT scan 43(43%). ischemia was the main positive finding in both MRI and CT scan.

We see that the difference between MRI and CT scan was the ability to detect ischemia and multiple sclerosis. There was a significant association between MRI finding and study variables the P

value for gender 0.041 and for history of chronic disease was 0.001 and for associated symptoms was 0.001, so the P value ≤ 0.05 (**table 5**)

Table 5: Association between MRI findings and study variables

Study variables	MRI findings		χ^2	P-value
	Positive	Negative		
Gender				
Male		4 (26.7)	4.181	0.041*
Female	47 (55.3)	11 (73.3)		
Total	38 (44.7)	15 (100.0)		
History of chronic diseases				
Present		1 (6.7)	20.915	<0.001*
Absent	59 (69.4)	14 (93.3)		
Total	26 (30.6)	15 (100.0)		
Associated symptoms				
Present	73 (85.9)	6 (40.0)		<0.001*f
Absent	12 (14.1)	9 (60.0)		
Total	85 (100.0)	15 (100.0)		

*p value ≤ 0.05 was significant. f : Fisher-exact test.

In comparison to MRI finding The sensitivity of CT scan to detect the causes of vertigo in this study was 50.58% that mean CT scan was able to detect finding in about 50.58% of patient

with vertigo .the specificity of CT scan was 100% that mean CT scan was able to detect all persons with vertigo which really has no finding (**table 6**).

Table 6: Sensitivity, specificity, positive, negative predictive value and overall accuracy of CT findings in comparison to MRI finding

CT findings versus MRI finding		MRI finding		Total
		Positive	Negative	
CT findings	Positive	43	0	43
	Negative	42	15	57
	Total	85	15	100

Sensitivity = $(43/85) \times 100 = 50.58\%$

Specificity = $(15/15) \times 100 = 100.0\%$

PPV= $(43/43) \times 100 = 100.0\%$

NPV= $(15/57) \times 100 = 26.31\%$

Overall accuracy = $(43+15/100) \times 100 = 58.0\%$

Ischemia was the main positive finding and it seen in 62 patient (62%) at age group 40-78 years with one or two risk factor like hypertension, diabetes mellitus, or ischemic heart disease

Discussion

One hundred patients complaining of vertigo were screened 51(51%) male and 49(49%) female. CT scan and MRI was done for each of them, we find that: M:F

ratio 1.04:1 aged 18-78 years. The main associated symptoms in this study was nausea and this disagrees with Hanley in 2001 which finds that nausea and vomiting are less common with central vertigo [9]. In this study ischemia was the main positive finding in patients with vertigo and this agrees with Hanley in 2001 that finds the vascular diseases of the brain are the main cause of vertigo. In this study all ischemia that was seen by CT scan and MRI was in patients who consult a private clinic or outpatient clinic after a period from feeling of vertigo to take a treatment and then send to take a date for CT scan examination and this period takes at least two weeks so the patient will present with chronic ischemia which is detected in 30 patients by CT scan and 32 not detected by CT scan due to a very small size or location of ischemia close to the skull vault. Otitis media and mastoiditis which is not listed with the causes of vertigo may be the cause of vertigo and this agrees with Hanley that finds the mastoiditis and otitis media may be considered as a cause of vertigo which may be clinically associated with tinnitus or hearing loss. Multiple sclerosis also not seen by CT scan but detected by MRI. CT scan can detect large intracranial masses like cerebello-pontine angle masses. Finding in 76 patients (76%) in this study refer to a central cause of vertigo and that means the neurologist and otolaryngologist refer the patient for brain MRI or CT scan after a perfect clinical examination with higher suggestion of central causes. From the result of the study the difference between MRI and CT scan was the ability to detect ischemia which is the major finding in this study in addition to multiple sclerosis in patients suffering from vertigo. Lawhn-Heath in 2013 finds that MRI has a high ability than CT scan to detect the cause of vertigo and the superior sensitivity of non-radiating magnetic imaging resonance makes it the imaging modality of choice in patients complaining of vertigo, also finds that CT scan had low sensitivity 26% compared with 83% for MRI in detection of posterior fossa

pathology and ischemic stroke. Chalela found that MRI is a preferred imaging modality than CT scan in diagnosis of ischemia in patients with vertigo, MRI sensitivity is higher 83% than sensitivity of CT scan 26% for detecting ischemic stroke. Hwang found that the sensitivity of CT scan is 41.8% for detection of posterior fossa infarction. Ozakin in 2012 finds that CT scan does not always detect central causes of vertigo compared with the high ability of MRI to detect it. Grewal in 2015 finds that CT scan is less sensitive to detect ischemia at the posterior fossa and it is not preferred to evaluate stroke in patients with vertigo. In this study we find that the ability of CT scan to detect central causes of vertigo is less than that of MRI and the sensitivity of CT scan was 50.58% while in above studies was 26% and 41.8%, the increased level of CT scan sensitivity in this study was due to the long period of time from beginning of symptoms to the time of CT scanning in which the ischemic area becomes more hypodense that increases the ability of CT scan to detect it while in above studies CT scan examination was done within 36 hours. The sensitivity of MRI cannot be calculated in this study because there is no false negative finding in MRI so we depend on previous studies that calculate the sensitivity of MRI as 83% which is higher than that of CT scan, that means MRI has higher ability than CT scan to detect central causes of vertigo and this agrees with several studies [1, 6, 10, 11, 12].

Conclusion

MRI plays an important role than CT scan in evaluation of patients with vertigo and has a high ability to detect central causes than CT scan. MRI should be the first imaging modality if the central causes of vertigo are suggested. Ischemia was the main cause of vertigo in middle and old age groups. Sensitivity of CT scan has a direct relation with the time from beginning of symptoms to CT scan examination.

Acknowledgments

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