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Araştırma / *Research Article*

Diagnostic Value of Diffusion Magnetic Resonance Imaging in the Emergency Department

Acil Serviste Difüzyon Manyetik Rezonans Görüntülemenin Tanısal Değerliliği

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ABSTRACT

Objective: *Ischemic stroke is one of the most common causes of disability and death worldwide. Our aim in this study was to investigate the diagnostic value of DW-MRI in patients with ischemic stroke who were admitted to the emergency department., and to emphasize the necessity and importance of imaging modalities.*
Method: *The study was performed retrospectively between 05.01.2018 and 06.31.2018 in Adult Emergency Department of our hospital. A total of 1303 patients who underwent diffuse magnetic resonance imaging in the emergency department were included in the study. Age, sex, complaints on admission of the patients, whether computed tomography revealed hypodensity, and DW-MRI showed signs of ischemic stroke were also recorded.*
Results: *A total of 1303 patients including 745 female (57.2%) , and 558 (42.8%) male cases were enrolled in our study. The mean. age of the patients (range; 11-95) was 54.29±18.73 years. In 5.4% (n=70) of the cases, there were hypodense areas on CCT and in 11.1% (n=145), DW-MRI revealed signs of ischemic stroke, while 82.9% of patients with hypodense area on CCT showed ischemic stroke on DW-MRI (p=0.001)*
Conclusion: *Especially in patients with a speech disorder, impaired consciousness, numbness and weakness in one half of their bodies, performing a DW-MRI at the first appropriate time and initiation of diagnosis and treatment faster and more accurately are thought to be important steps in reducing and even preventing mortality and morbid outcomes in emergency departments.*

Keywords: *diffusion-weighted MRI, emergency department, diagnosis*

ÖZ

Amaç: *İskemik inme, dünya genelinde engelliliğe ve ölüme en sık neden olan hastalıklar içinde yer almaktadır. Bu çalışmada amacımız; acil servise başvuran hastalarda D-MRG çekilen hastaları inceleyerek, yapılan görüntüleme yöntemlerinin gerekliliğini ve önemini vurgulamaktır.*
Yöntem: *Çalışma 01.05.2018-31.06.2018 tarihleri arasında hastanemiz Erişkin Acil Servisinde retrospektif olarak gerçekleştirildi. Çalışmaya acil serviste difüzyon manyetik rezonans görüntüleme istenmiş 1303 hasta dahil edildi. Hastalara ait yaş, cinsiyet, başvuru şikâyetleri, bilgisayarlı tomografilerinde hipodens alan olup olmadığı ve D-MRG'de iskemik inme bulgularının olup olmadığı kaydedildi.*
Bulgular: *Çalışmamıza toplam 1303 hasta alınmış olup, 745'i kadın (%57,2), 558'i erkek (%42,8) idi. Hastaların ortalama yaşı (sınır; 11-95) 54,29±18,73 yıl idi. Olguların %5,4'ünde (n=70) BT'de hipodens alan ve %11,1'inde (n=145) D-MRG'de iskemik inme bulguları saptandı. BT'de hipodens alanı olan hastaların %82,9'unda D-MRG'de de iskemik inme bulgularının olduğu görüldü (p=0.001).*
Sonuç: *Özellikle konuşma ve bilinç bozukluğu, vücut yarımında uyuşma ve güçsüzlük olan hastalarda D-MRG tetkikinin uygun olan ilk anda yapılmasının, tanı ve tedavinin daha hızlı ve daha doğru bir şekilde başlatılması ile acil servislerde mortal ve morbid sonuçları azaltma ve hatta önlemede önemli bir adım olduğu düşünülmektedir.*

Anahtar kelimeler: *difüzyon ağırlıklı MRG, acil servis, tanı*

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INTRODUCTION

Ischemic stroke is one of the most common causes of disability and death worldwide. Rapid diagnosis and treatment of the disease are crucial in reducing mortality and morbidity due to the importance of time in treatment options such as thrombolytic treatment, and thrombectomy. Ischemic stroke is typically manifested by sudden onset of neurological deficits, but the symptoms vary according to the affected brain region. Hemianopsia, hemiplegia, hemiparesis, dysphagia, dysmetria, bulbar palsy, impaired consciousness, diplopia, or vertigo are commonly , while headache and neck pain are less less frequently seen. Although there are some clinical findings that can be used to differentiate between hemorrhagic, and ischemic stroke, none of the clinical findings can 100% differentiate between ischemic, and hemorrhagic stroke. Therefore, brain and neurovascular imaging are indispensable diagnostic tools for suspected stroke cases [(1)].

Although the mainstay for the diagnosis of ischemic stroke is cranial tomography (CT) , diffusion-weighted magnetic resonance imaging (D-MRI) is gaining predominancy because of the significant improvements in radiology and ease of access to imaging methods [(2)]. CT may play an important role in imaging ischemic stroke but is insensitive in minor ischemic stroke imaging [(1)]. Thus, D-MRI is more prevalently used in cases of suspected ischemic stroke, especially by emergency physicians.

The aim of this study was to examine the patients who were admitted to the emergency department and underwent D-MRI and to emphasize the necessity and importance of imaging modalities.

MATERIAL and METHOD

The study was performed retrospectively between 05.01.2018 and 06.31.2018 in Adult Emergency Department of our hospital after obtaining approval of the Ethics Committee. A total of 1303 patients who underwent diffuse magnetic resonance imaging in the emergency department were included in the study by scanning the Hospital Information Management System (HIS) and patient files. Age, sex, complaints on admission of the patients (headache, dizziness, speech disorder, nausea-vomiting, syncope, seizure, disorders of general health condition, numbness, aadn /or weakness involving one half of the body, loss of vision), whether computerized tomography revealed hypodensity, and D-MRI showed signs of ischemic stroke were recorded.

All patient data were recorded in the case data form and NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for statistical analysis. In addition to descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum), Student's t Test was used for comparison of quantitative data between two groups showing normal distribution and Mann-Whitney U test was used for comparison of two groups of data without normal distribution. Pearson chi-squared test, Fisher-Freeman-Halton Exact test and Fisher's Exact test were used to compare qualitative data. A significance level of at least $p<0.05$ was assessed.

RESULTS

A total of 1303 patients including 745 female (57.2%), and 558 (42.8%) male cases were enrolled in our study. The mean age of the patients (range; 11-95) was 54.29±18.73 years. Complaints of the patients participating in the study were dizziness (n=448: 34%), headache (n=401: 31% 11%), numbness affecting one half of the body (n=1088%) nausea and vomiting, syncope (n=106: 8%), impaired general health state (n=66: 5%), impaired consciousness (n=66: 5%), speech disorder (n=53: 4%) weakness involving one half of the body (n=46: 4%), facial numbness3% (n=42: 3%), seizure (n=29: 2%), and loss of vision (n=15: 1%) (Table 1).

Table 1. Distribution of symptoms of patients on admission.

	n (%)
Symptoms on Admission	
Dizziness	448 (34)
Headache	401 (31)
Speech Disorder	53 (4)
Syncope	106 (8)
Seizure	29 (2)
Nausea-vomiting	108 (8)
General condition disorder	66 (5)
Weakness in one half of the body	46 (4)
Numbness in one half of the body	140 (11)
Impaired consciousness	66 (5)
Facial numbness	42 (3)
Loss of vision	15 (1)

• *Some of the patients have more than one symptom*

Table 2. Evaluations on hypodense area on CCT.

	Hypodense Area on CCT			
	None (n=1233)	Present (n=70)	p	Odds (95% CI)
	n (%)	n (%)		
•Symptoms on Admission				
Dizziness				
No	798 (65)	57 (81)	***0.004***	0.41
Yes	435 (35)	13 (19)		(0.22-0.77)
Headache				
No	846 (69)	56 (80)	***0.045***	0.54
Yes	387 (31)	14 (20)		(0.30-0.99)
Speech disorder				
No	1190 (97)	60 (86)	***[a]0.001***	4.61
Yes	43 (3)	10 (14)		(2.21-9.62)
Syncope				
No	1131 (92)	66 (94)	***0.446***	0.67
Yes	102 (8)	4 (6)		(0.24-1.88)
Seizure				
No	1207 (98)	67 (96)	***[a]0.201***	2.07
Yes	26 (2)	3 (4)		(0.61-7.04)
Nausea-vomiting				
No	1130 (92)	65 (93)	***0.721***	0.84
Yes	103 (8)	5 (7)		(0.33-2.14)
General condition disorder				
No	1170 (95)	67 (96)	***[a]1.000***	0.83
Yes	63 (5)	3 (4)		(0.25-2.72)
Weakness in one half of the body				
No	1197 (97)	60 (86)	***[a]0.001***	5.54
Yes	36 (3)	10 (14)		(2.62-11.67)
Numbness in one half of the body				
No	1108 (90)	55 (79)	***0.003***	2.42
Yes	125 (10)	15 (21)		(1.32-4.40)
Impaired consciousness				
No	1176 (95)	61 (87	***[a]0.007***	3.04
Yes	57 (5)	9 (13)		(1.44-6.43)
Facial numbness				
No	1194 (97)	67 (96)	***[a]0.490***	1.37
Yes	39 (3)	3 (4)		(0.41-4.55)
Loss of vision				
No	1219 (99)	69 (99)	***[a]0.565***	1.26
Yes	14 (1)	1 (1)		(0.16-9.73)

[a] Fisher's Exact Test CI: Confidence Interval

In 5.4% (n=70) of the cases, there were hypodense areas on CT and in 11.1% (n=145), diffusion MRI revealed signs of ischemic stroke. Hypodense area was seen in patients with dizziness (19%: p=0.004), headache (20%: p=0.045), speech disorder (14%: p=0.001), weakness, and numbness involving one half of the body (14%: p=0.001, and 21%: p=0.003, respectively), and impaired consciousness (13%: p=0.007) (Table 2).

Table 3. Assessments on Symptoms on Admission and Presence of Ischemic Stroke on D-MRI.

	Hypodense Area on CCT			
	None (n=1158)	Present (n=145)	p	Odds (95% CI)
	n (%)	n (%)		
•Symptoms on Admission				
Dizziness				
No	740 (64)	115 (79)	***0.001***	0.46
Yes	418 (36)	30 (21)		(0.30-0.70)
Headache				
No	784 (68)	118 (81)	***0.001***	0.48
Yes	374 (32)	27 (19)		(0.31-0.74)
Speech disorder				
No	1132 (98)	118 (81)	***0.001***	9.96
Yes	26 (2)	27 (19)		(5.63-17.63)
Syncope				
No	1064 (92)	133 (92)	***0.948***	1.02
Yes	94 (8)	12 (8)		(0.54-1.91)
Seizure				
No	1129 (98)	145 (100)	***[a]0.066***	0.89
Yes	29 (2)	0 (0)		(0.86-0.94)
Nausea-vomiting				
No	1056 (91)	139 (96)	***0.054***	0.45
Yes	102 (9)	6 (4)		(0.19-1.04)
General condition disorder				
No	1103 (95)	134 (92)	***0.142***	1.65
Yes	55 (5)	11 (8)		(0.94-3.22)
Weakness in one half of the body				
No	1135 (98)	122 (84)	***0.001***	9.30
Yes	23 (2)	23 (16)		(5.07-17.07)
Numbness in one half of the body				
No	1047 (90)	116 (80)	***0.001***	2.36
Yes	111 (10)	29 (20)		(1.50-3.70)
Impaired consciousness				
No	1107 (96)	130 (90)	***0.002***	2.51
Yes	51 (4)	15 (10)		(1.36-4.58)
Facial numbness				
No	1122 (97)	139 (96)	***[a]0.457***	1.35
Yes	36 (3)	6 (4)		(0.55-3.25)
Loss of vision				
No	1145 (99)	143 (99)	***[a]0.679***	1.23
Yes	13 (1)	2 (1)		(0.27-5.51)

[a] Fisher's Exact Test CI: Confidence Interval

Signs of ischemic stroke on D-MRI were observed in patients with dizziness (21%: p=0.001), speech disorder (19%: p=0.001), in 16% of those with weakness, and numbness involving one half of the body (16%: p=0.001, 20%: p=0.001, respectively), and impaired consciousness (10%: p=0.002) (Table 3).

The a statistically significant relationship was found between the frequency of speech disorder in patients with ischemic stroke detected on D-MRI (p=0.001).

Table 4. The relationship between DW-MRI and CCT results.

	Hypodense Area on CCT			
	Total	None	Present	p
	n (%)	n (%)	n (%)	
Ischemic Stroke on DW-MRI				
None	1158	1146 (92.9)	12 (17.1)	***0.001***
Present	145	87 (7.1)	58 (82.9)	
Total	1303	1233	70	

The frequency of speech disorder in patients with ischemic stroke detected on D-MRI was higher than those without. Similarly, the rates of weakness, and/or numbness in one half of the body, (p=0.001) and impaired consciousness were higher in patients with ischemic stroke detected on D-MRI than those without (p=0.002). Also 82.9% of patients with hypodense area on CT showed signs of ischemic stroke on D-MRI (p=0.001) (Table 4).

DISCUSSION

Today, ischemic stroke is considered as one of the most important causes of mortality and morbidity. Stroke symptoms may be misevaluated by clinicians and patients from time to time, although it is a well-known disease, particularly by emergency medical practitioners [3]. This erroneous evaluation may lead to negligence in preventing the subsequent development of greater ischemic areas and in initiating the appropriate treatment. Although the symptoms vary according to the affected brain area, patients may often present with a speech disorder, weakness and numbness involving one half the body, and facial numbness [4]. In their study, Çıgsar et al. have reported that the most common three complaints in the patients with ischemic stroke were in order of decreasing frequency are weakness in one half of the body, speech disorder, and impaired consciousness [5]. In another study, similarly, Kıyan et al. reported that the most common complaints in 124 patients diagnosed with ischemic stroke were the weakness involving one half of the body, speech disorder, and altered states of consciousness [6]. In our study, the most common complaints of the patients diagnosed with acute ischemic stroke were found to be numbness, and weakness involving one half of the body, speech disorder, and altered states of consciousness which are consistent with the literature findings.

Emergency medicine specialists should consider many diseases in the differential diagnosis of the cases with suspected ischemic stroke. Although focal and acute neurological deficits are descriptive features of ischemic stroke, many patients, especially women, can present with atypical complaints such as general condition disorder, malaise, dizziness, impaired consciousness [4]. One of the most important symptoms that cause confusion in physicians during the process of differential diagnosis and leads to request of unnecessary imaging modalities is dizziness [7]. Dizziness occurs as one of the accompanying symptoms in many diseases of central or peripheral origin. In our study, 20.7% of patients with the complaint of dizziness had signs of ischemic stroke on D-MRI. Although statistically significant, we believe that this low rate is due to the high number of patients presenting to the emergency room with dizziness.

Although the risk of life-long stroke is thought to be higher in men than in women, recent studies have shown that the risk of stroke is also increasing in women [8,9]. Reports indicating that the risk of stroke in women between 55-75 years of age is at a rate of 20% while this rate is 14-17% in men, support this information [8]. Similarly, female gender is at the forefront in symptoms such as headache, dizziness, etc. which may cause confusion in clinicians and/or some diseases involved in the differential diagnosis of ischemic stroke. In our study, 57.2% of the patients who underwent D-MRI were female and 42.8% of them were male. This finding may be explained by the presentation of female patients to the emergency department of our hospital more frequently with ischemic stroke-like symptoms which is compatible with the literature data.

Acute treatment of ischemic stroke is a time-dependent disease. The aim of stroke treatment is to achieve early – onset intracranial reperfusion [10]. In many studies in the literature, the time between the onset of symptoms and thrombolytic therapy was investigated and early-onset treatment was found to change the mortality and morbidity significantly. Today, CT is a more common and relatively more economical imaging method with high availability compared to MRI. Because of its widespread use in the diagnosis of many cranial diseases for many years, it is accurately assessed, especially by emergency physicians at a higher rate. However, CT is

known to be insensitive to identify minor infarct areas. In cases where symptoms are prominent and the diagnosis of stroke is clinically, and highly suspected, the differentiation between ischemic, and hemorrhagic stroke by CT may be sufficient to determine treatment. However, the absence of hypodense area on CT which is suggestive of ischemic stroke may not rule out the suspicion of ischemic stroke in cases of minor ischemia in which the symptoms and signs are not sufficient to exclude other diseases included in the differential diagnosis of ischemic stroke. D-MRI is a more effective radiological imaging method compared to CT in the evaluation of hyperacute and acute infarcts with a sensitivity of 88-100% and a specificity of 86-100 percent [(11)]. It may show minor infarct areas even within the first hour from the onset of symptoms. As reported in the literature, signs of ischemic stroke on D-MRI have been observed in 7.1% of patients, although they were not detected on CT in our study.

MRI is a high-tech imaging method used to diagnose many diseases by allowing the human body to be displayed in high contrast resolution. Since it was first introduced in 1973, it is known to be a relatively reliable diagnostic practice due to the fact that radiation is not used, and its equipment is gradually perfecting thanks to technological developments [(12)]. Recently, D-MRI is being more frequently employed in the emergency department along with extensive use of MRI in the health facilities of our country. In hospitals with heavy work load but insufficient number of physicians, imaging methods are widely used because of the shortage of time allocated to the patient and the concern about medical malpractice. Using an imaging method with high sensitivity and specificity without causing any loss of time in diseases requiring a time-dependent treatment protocol, such as ischemic stroke reduces the risk of misdiagnosis in hospitals where MRI is available which is preferred by physicians. We reviewed 1303 cases who had D-MRI within two months. Since the time to reach D-MRI and CT in our hospital is the same, the use of D-MRI for definitive diagnosis in patients with suspected ischemic stroke is considered to be beneficial both to refrain from a misdiagnosis and to recognize ischemic stroke patients at an early stage.

CONCLUSION

Imaging methods should be used at an early stage in patients who presented to the emergency room with complaints that will cause suspicion of ischemic stroke and whose neurological examination revealed neurological deficits. Therefore, especially in patients with a speech disorder, impaired consciousness, numbness and weakness involving one half of the body who had a D-MRI at the first appropriate time and initiation of diagnosis and treatment faster and more accurately are thought to be important steps in reducing and even preventing mortality and morbid outcomes in emergency departments. In addition, the use of D-MRI for the detection of infarct areas that may be missed on CT is thought to be significant in patients who had nonspecific complaints such as dizziness, nausea-vomiting, headache and/ or minor infarct areas and had a risk factor for ischemic stroke and whose neurological examination did not manifest pathological signs but with complaints refractory to symptomatic treatment.

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