

C arotid Doppler-related risk factors in ischemic stroke patients

Factores de riesgo relacionados con el Doppler carotídeo en pacientes con accidente cerebrovascular isquémico

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Abstract

In accordance to the World Health Organization data (WHO), deaths have been increased in Iraq due to factors related to strokes in the annual population. The aim of this article is to study and discuss the radiological assessments of Doppler images that related to the possible risk factors. This study compares the frequency of risk factors among present stroke patients with the previous Iraqi studies. This study is also carried out the patients who are hospitalized from January 2020 to February 2022 with the radiological assessments of stroke diagnostics, including: Electrocardiography (ECG), Echocardiography (2D mode and M-mode types), Brain Computed Tomography (CT-scan) and Carotid Doppler. Males' inclusion showed higher mean age than females (<0.01), and the majority of male patients ($n=28$; 43.75%) and females patients ($n=20$; 41.67%) were aged greater than 70 years. Hypertension, diabetes, and dyslipidemia were the dominant risk factor in older ages (≥ 70 years). Carotid Doppler ultrasound scanning is performed on the abnormality's patients in which (75.71%) had ipsilateral stenosis while others had bilateral stenosis. Age, body-mass index, hypertension, diabetes mellitus and dyslipidemia were found to be associated with the types of stenosis; whereas, obesity, hypertension, and diabetes were significantly associated with a hetero-plaque.

Keywords: Carotid Doppler, Ischemic Stroke, Risk Factors, Stroke Death.

Resumen

Según datos de la Organización Mundial de la Salud (OMS), las muertes en Irak han aumentado debido a factores relacionados con los accidentes cerebrovasculares en la población anual. El objetivo de este artículo es estudiar y discutir las valoraciones radiológicas de las imágenes Doppler relacionadas con los posibles factores de riesgo. Este estudio compara la frecuencia de factores de riesgo entre los pacientes actuales con accidente cerebrovascular con los estudios iraquíes anteriores. Este estudio también se lleva a cabo en los pacientes que están hospitalizados desde enero de 2020 hasta febrero de 2022 con evaluaciones radiológicas de diagnóstico de accidente cerebrovascular, que incluyen: electrocardiografía (ECG), ecocardiografía (tipos modo 2D y modo M), tomografía computarizada del cerebro (escaneo por TC) y Doppler carotídeo. La inclusión de hombres mostró una edad media más alta que la de las mujeres ($<0,01$), y la mayoría de los pacientes masculinos ($n=28$; 43,75%) y mujeres ($n=20$; 41,67%) tenían edades superiores a 70 años. La hipertensión, la diabetes y la dislipidemia son el factor de riesgo dominante en edades más avanzadas (≥ 70 años). La ecografía Doppler carotídea se realiza en los pacientes con la anomalía en los cuales (75,71%) tenían estenosis ipsilateral mientras que otros tenían estenosis bilateral. Se encontró que la edad, el índice de masa corporal, la hipertensión, la diabetes mellitus y la dislipidemia estaban asociados con los tipos de estenosis; mientras que la obesidad, la hipertensión y la diabetes se asociaron significativamente con una heteroplaca.

Palabras clave: Doppler carotídeo, ictus isquémico, factores de riesgo, muerte por ictus.

The Global Burden of Disease (GBD) considered that strokes are the second most common cause of death worldwide¹. World Health Organization (WHO) reported that strokes are responsible for approximately 0.11 of the world's total deaths in 2019². Since the brain is supplied by two internal carotid arteries and two vertebral arteries, consequence of vascular disease led to brain thromboembolism and that cause ischemic stroke. Risk factors that involved in the occurrence of ischemic stroke have been recognized as modifiable, such as hypertension, dyslipidemia, diabetes mellitus, atrial fibrillation, smoking, or non-modifiable risk factors such as gender, age, ethnicity, heredity, and race³. The massive death has been increased in Iraq due to the stroke as reported on the World Health Organization (WHO) data. Within two years (2018-2020), the total stroke deaths increased from 6.53% to 14.19%. In 2018, the age adjusted death in Iraq was rated 75.79 per 100,000 of population and ranked 85 in the world; while in 2020, it was rated 128.44 per 100,000 of population and ranked 31 in the world. As a result, the stroke is the third leading cause of death in Iraq⁴. Few studies dealt with ischemic stroke in Iraqi cities, that is, three studies were involved patients in Duhock⁵⁻⁷, three in Baghdad^{4,8,9}, two in Erbil^{10,11}, and one study in Basrah¹², Al-Diwanya¹³, DIALA¹⁴, and Babylon¹⁵. The present study was done in Al-Najaf Province and aimed to view the results of radiological assessments and Colored Doppler images that related with possible risk factors and compared with the frequency of risk factors among present stroke patients and also with previous Iraqi studies.

Patients & methods

The observational study was carried out on 112 patients presented with clinical ischemic stroke, who were admitted in Al-Sadder Teaching Hospital, Al-Najaf Province, Iraq from January 2020 to February 2022. All patients showed evidence of carotid-ischemic infarction confirmed with CT/MRI scan. Exclusion the possible source of cardio embolism was done by Echocardiography. Patients enrolled in this study (62 males and 50 females) were aged between 40-86 years. Details history was taking regarding hypertension, diabetes, smoking, using oral contraceptives, drug history and previous history of stroke or transient ischemic attacks. Body mass index (BMI), which considered as risk factor, was determined according to recent article of Pengpid and Peltzer¹⁶ for Iraqi population and ranged as following: <18.5 kg/m² as underweight patients, 18.5-24.9 kg/m² as normal weight, 25.0 – 29.9 kg/m² as overweight and ≥30.0 kg/m² for obese patients.

Routine laboratory investigations were done to all patients using blood biochemistry including lipid profiles,

blood sugar (fasting, 2h post prandial and glycated hemoglobin HbA1C), and liver and kidney function tests. Radiological assessments were also done using Electrocardiography (ECG), echocardiography (2D mode and M-mode types), Brain computed tomography CT-scan and carotid Doppler. CT-scan was the most important determinant of the final diagnosis of the stroke types. The Trial of Org 10172 in Acute Stroke Treatment (TOAST) criteria was used to assess lacunar infarction. Carotid Doppler was carried out using color Doppler image (7.5 MHz by linear probe) to detect the degree of stenosis together with plaque morphology to classify them whether hetero, homo, or indeterminate. Sonographic feature of homo-plaque as a uniform echopattern most consisted of low-level echoes; the surface margin of plaque is always smooth. In contrast, the echo pattern of hetero-plaque was complex in nature contains focal anechoic areas.

Statistical Analysis

The statistics software IBM SPSS V.26 was used for all data processing. Descriptive and inferential statistics analyses were performed. To assess the risk factors relationships with components of ischemic stroke, univariate and multivariate logistic regression analyses were used. Statistical tests were performed at a significance level of $P \leq 0.05$. Demographical database of patients involved in this study is shown on the Tables 1, 2 and 3. Male ages were significantly higher than female ages (<0.01), the majority of male ($n=28$; 43.75%) and female patient's age ($n=20$; 41.67%) were ≥ 70 years. In respect to BMI, the higher percentage, about 0.35, of both genders were obese.

Table 1: Age records of patients

Gender	Min	Max	Mean \pm SD
Males	44	86	67.19 \pm 9.88
Females	40	81	56.94 \pm 11.17

Table 2: Gender distribution of patients with respect to age groups (n=112)

Age	Males (n=62)	Females (n=50)	Total
< 50	10(16.13)	12(24.00)	22(19.64)
50-69	24(38.71)	18(36.00)	42(37.50)
≥ 70	28(45.16)	20(40.00)	48(42.86)
Total	62(55.36)	50(44.64)	112

Table 3: Gender distribution of patients with respect to BMI (n=112)

BMI	Male	Female	Total
Underweight	11(17.18)	8(16.67)	19(16.96)
normal weight	13(20.31)	9(18.75)	22(19.64)
Overweight	18(28.13)	14(29.17)	32(28.57)
Obese	22(34.38)	17(35.42)	39(34.82)
Total	64(57.14)	48(42.86)	112

The risk factors of ischemic stroke in relation with age and BMI were showed in Table 4. Hypertension, diabetes, and dyslipidemia were the dominant risk factor in older age group (≥ 70 years), whereas smoking in mid-age patients (50- 69 years) had higher proportion stroke risks than in elderly patients which was significant. Whilst all these risk factors were significantly higher in obese patients than others.

Carotid Doppler ultrasound scanning was performed on 112 patients and showed 70 patients (62.5%) had carotid stenosis of them 53 (75.71%) had ipsilateral stenosis, while the rest had bilateral stenosis (Table 5).

Among seven risk factors, including univariate ordinal logistic regression, five factors were found to be associated with types of stenosis, e.g. age, Body Mass Index (BMI), Hypertension (HT), Diabetes Mellitus (DM) and Dyslipidemia (DL), as shown in Table 6.

The results of multivariate analysis revealed that patients having ipsilateral stenosis were 2.29 times higher than obese (95% CI: 1.71- 3.11). Hypertension had 4.13 times (95% CI: 2.2-6.41) greater than patients having Ipsilateral Stenosis compared with patients having bilateral stenosis. Diabetic patients had found significantly higher with Ipsilateral Stenosis than bilateral stenosis with OR of 3.82 (95% CI: 1.3-4.26). Patients with dyslipidemia had Ipsilateral Stenosis 2.18 fold (95% CI: 1.01-2.41) greater than patients having bilateral stenosis. Table 7 shows the results of univariate and multivariate logistic regression analysis of risk factors in relation to type of Plaque. Three factors were significantly associated with hetero- plaque: obesity (OR 2.39, 95% CI 1.82-3.45), HT (OR 3.61, 95% CI 1.1-5.32), and DM (OR, 3.32 95% CI 1.4-4.96); whereas age, sex, DL and smoking showed no significant relations.

Table 4: Stroke risk factors in relation to age and BMI

Age (Years)	Hypertension	Diabetes	Dyslipidemia	Smoking	Obesity
< 50 (n=22)	12(54.54)	14(63.63)	8(36.36)	17(77.27)	0.000
50-69 (n=42)	35(83.33)	30(71.43)	32(76.19)	36(85.71)	
≥ 70 (n=48)	42(87.5%)	40(83.33)	38(79.17)	32(66.67)	
Total (112)	89(79.46)	84(75.00)	78(69.64)	83(74.11)	
BMI Underweight (n=19)	8(42.10)	8(42.10)	10(52.63)	9(47.37)	0.000
BMI normal weight (n=22)	14(63.63)	12(54.54)	16(72.72)	12(54.54)	
BMI Overweight (n=39)	36(92.31)	34(87.18)	24(61.53)	33(84.61)	
BMI Obese (n=32)	31(96.86)	30(93.86)	29(90.62)	29(90.62)	
Total (112)	89(79.46)	84(75.00)	78(69.64)	83(74.11)	

Table 5: Doppler findings of present patients

Result	N (%)
Normal Doppler	42 (37.50)
Carotid Stenosis	70 (62.50)
Ipsilateral Stenosis	53 (75.71)
Bilat Stenosis	17 (24.29)

Table 6: Risk factors in relation to type of tenosis

Variables	Ipsilateral Stenosis	Bilateral Stenosis	Univariate Analysis P value	Multivariate Analysis		
				B	OR (95% CI)	P value
Age (Mean \pm SD)	60.63 \pm 10.47	68.12 \pm 9.32	0.046	0.32		
Sex(M/F), %	51/49	52/48	0.132	0.28	1.07(0.82-1.91)	NS
BMI(Obese), %	59.82	46.14	0.011	0.27	2.29(1.71-3.11)	0.000
HT, %	82	56	<0.001	0.61	4.13(2.2-6.41)	0.000
D.M, %	53	32	<0.001	0.82	3.82(1.3-4.26)	0.000
DL, %	74	34	<0.001	0.51	2.18(1.01-2.41)	0.002
SM	43	48	0.62	0.13	0.91(0.7-1.2)	0.66 NS

Table 7: Risk factors in relation to type of plaque

Variables	Hetero-plaque	Homo-plaque	Univariate Analysis @P	Multivariate Analysis		
				β	OR (95%CI)	P
Age (Mean \pm SD)	66.12 \pm 9.61	62.23 \pm 9.81	0.13NS	0.02		
Gender (M/F), %	58/42	41/59	0.16NS	0.97	1.30(1.4-2.6)	0.30NS
BMI (Obese), %	69.23	34.24	0.003	0.79	2.39(1.82-3.45)	0.000
HT, %	87	52	<0.001	0.43	3.61(1.1-5.32)	0.000
D.M, %	76	43	<0.001	0.72	3.32(1.4-4.96)	0.000
DL, %	45	42	0.72 NS	0.26	1.12(0.81-1.41)	0.63 NS
SM	35	33	0.55NS	0.11	0.96(0.3-1.4)	0.32NS

Broad spectrum of risk factors for ischemic stroke were cited by previous studies such as age, sex, obesity, hypertension, diabetes, dyslipidemia, smoking, and others¹⁷⁻²³. In our study, the mean age of patients with ischemic stroke was 67.19±9.88 years of male and 56.94±11.17 years of females, with majority of cases 48(42.86%) in the age group of ≥70 years. The incidence of ischemic stroke increased with advancing age and this in agreement with studies in other countries²²⁻²⁶. Obesity is one of the factors that can increase the possible incidence of the ischemic stroke, in the present study the overweight and obese patients composed more than 70% of studied sample, other studies also confirmed that obesity was predictive factor for ischemic stroke^{23,27,28}. The recent studies showed diabetes is important covariate affect the types of stroke [29], nevertheless, traditional risk factors were identified hypertension 79.46%, diabetes 75.00%, smoking 74.11%, and dyslipidemia 69.64%^{20,30-32}. In general, this study has been done on the Iraqi patients from different cities showed different incidence ratios of strokes due to the risk factors, however, hypertension is the riskiest factor; especially, in the older patients, and hypertension was an epidemic disease in different regions in Iraq³³⁻³⁵. Our study evaluates risk factors in relation to type of stenosis, showed that both univariate and multivariable analysis outcome presented that obesity, hypertension, diabetes, and dyslipidemia were predictive risk factors for Ipsilateral Stenosis. Recent study stated that Age >80 years, the only independent risk factors for late ipsilateral IS in a multivariable Cox regression model including 13 clinical factors³⁶.

Table 8: Ischemic stroke risk factors in different Iraqi cities.

Author	City	Risk factors			
		HT	DM	S	DL
Al-Shimmery,2010	Erbil	31.3%	18.8%	29.7%	36.4%
Al-Asadi,2014	Basrah	66.2%	28.0%	28.4%	-
Al-Khazraji 2016	Baghdad	40.0%	26.0%	22.0%	-
Sulaiman,2017	Duhok	59.8%	08.1%	20.1%	24.7%
Almusawi, 2021	Babylon	71.9%	38.6%	18.8%	-
Present study	AlNajaf	79.46%	75.00%	74.11%	69.64%

Assessing risk factors for ischemic stroke patients is crucial for identifying individuals at higher risks of developing. A comprehensive assessment includes evaluation of modifiable and non-modifiable risk factors, such as hypertension, diabetes, smoking, high cholesterol, atrial fibrillation, age, gender and family history of stroke. To evaluate risk factors in relation to the type of stenosis, type of plaque univariate and multivariate logistic regression analyses were used. Recent studies show that both univariate and multivariate analyses outcomes present old ages, obesity, hypertension, diabetes, and dyslipidemia most predictive risk factors for ischemic stroke subtypes. In terms of our knowledge, this is the first time this result is reported with the Iraqi patients, whilst obesity, hypertension, and diabetes are shown more available in hetero- plaque types.

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