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PROGNOSIS OF PATIENTS WITH ACUTE ISCHEMIC STROKE THROUGH CLINICAL AND MAGNETIC RESONANCE IMAGE STUDIES

By

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ABSTRACT

Background: The prognostic factors for patients presented with acute cerebrovascular strokes, based upon MRI diffusion-perfusion mismatch, size of stroke and pre morbid risk factors to predict the outcome of the patients.

Objective: Assessment of cerebral infarction outcome through clinical and imaging study by using diffusion-weighted imaging and perfusion MRI**.**

Patients and Methods: Patients admitted in Neurology Department of Al-Azhar University Hospitals (Al-Hussein and Sayed Galal Hospitals), during the study period from 1/12/2015 to 30/7/2016, with diagnosis of acute cerebrovascular stroke. All patients were subjected to clinical assessment by NIHSS score at time of admission, radiologic assessment (infarction volume by MRI diffusion, MRI diffusion perfusion mismatch), and reevaluation after 1.5 months. Data were collected and analyzed by SPSS program, using t-test, chi square and ANOVA.

Results: The patients were classified into two groups: Group I: (26 patients) have good outcome, and Group II: (14 patients) have poor outcome according to clinical assessment by NIHSS score at time of admission and infarction size in MRI diffusion. The most predictive factors of patients with acute ischemic stroke outcome were history of uncontrolled diabetes, smoking, site of infarction, infarction volume by MRI diffusion, MRI diffusion perfusion mismatch and follow up radiology after one and half months the most significant statistical difference.

Conclusion: Control of diabetes, smoking cessation and other metabolic factors improved the outcome of patients with acute ischemic stroke. Radiological assessment of acute ischemic stroke patients by infarction size in MRI diffusion and degree of diffusion perfusion mismatch were mandatory for better assessment of the stroke severity and prediction of outcome.

Key words: Acute ischemic stroke, MRI, Infarction, Predictive factors.

INTRODUCTION

Stroke is a clinical syndrome of rapidly developing symptoms and signs of focal some time global loss of cerebral function with no apparent cause other than vascular origin, lasting more than 24 hours, or may lead to death **(Sacco et al., 2013).**

Stroke is a heterogeneous, multifactorial disease regulated by modifiable and non-modifiable risk factors. Modifiable factors include a history of high blood pressure, diabetes mellitus and coronary heart disease. Non-modifiable factors include age, sex, heredity and race. Other less-

well documented risk factors include geographic location, socioeconomic status and alcoholism **(Azra et al., 2016).**

The ischemic penumbra is an area of constrained blood flow with partially preserved energy metabolism surrounding the lethally damaged core. It contains functionally impaired but structurally intact tissue, and it is the battlefield where the ischemic cascade is triggered, resulting in ongoing cellular injury and infarct progression. The penumbra can be rescued by improving the blood flow and/or interfering with the ischemic cascade. Precisely, this is the target for acute stroke therapy **(Pedro et al., 2011)**.

MRI perfusion imaging represents a form of functional imaging that assesses alterations in blood flow with additional information on metabolism and regional measures of a specific tracer. This technique has been employed for a variety of conditions, but it is most commonly used in cerebrovascular disorders, especially acute ischemia **(Wintermark et al., 2013).**

The aim of the present work was to assess cerebral infarction outcome through clinical and imaging study by using diffusion-weighted imaging and perfusion MRI.

PATIENTS AND METHODS

This study included 80 patients with first ever-ischemic stroke admitted within 24 hours of the onset of symptoms,

Inclusion criteria: Patients with first time ischemic stroke, within the first 24 hours of their symptoms, with clinical and radiological data suggesting anterior circulation infarction.

Exclusion criteria:

1. Cerebral hemorrhage
2. Brain tumor and malignancy.
3. Recurrent stroke.
4. Posterior circulation infarction
5. Patients with contraindications for MRI.

All patients were subjected to

A-Clinical assessment:

1. Stroke onset.
2. Full general and neurological history and examination including demographic data: age, sex, occupation, family history of stroke, and history of stroke risk factors as smoking, hypertension, diabetes mellitus, hypercholesterolemia, atrial fibrillation (AF), and ischemic heart disease (IHD).
3. General and neurological examination.
4. Assessment of stroke severity using the National Institute of Health Stroke Scale Score (NIHSS) at admission.

B- Laboratory assessment:

Laboratory investigations included routine laboratory investigations (complete blood count (CBC), liver and renal function tests, erythrocytic sedimentation rate (ESR), lipid profile, serum uric acid, prothrombin time (PT), partial thromboplastin time (PTT), and international normalized ratio (INR).

C- Radiological Assessment:

1. Computed tomography (CT) to exclude hemorrhage.
2. Magnetic resonance imaging (MRI): MRI scan of the brain was performed on a 1.5 Tesla Magnetom Vision (Philips), diffusion weight image (DWI), T1, T2, flair, MR Perfusion, diffusion perfusion mismatch.
3. The follow-up study included routinely DWI and a conventional T2 weighted sequence.

Statistical analysis: Statistical presentation and analysis of the present study was conducted, using the mean, standard deviation, the Wilcoxon tests, linear correlation coefficient, Analysis of variance [ANOVA] test, paired t-test and

chi-square by SPSS. Significant results were considered if *p*-value was < 0.05. All statistical analyses were performed using SPSS 11.0 J for Windows.

RESULTS

This study included 80 patients with first time ischemic stroke admitted within 24 hours of the onset of symptoms. Patients became 40 patients after exclusion of 40 patients (11 patients died, 2 with space occupying lesion, 2 with renal failure, and 25 did not appear in the follow up). Patients were divided in two groups, those who had good outcome (26 patients), and those with bad outcome (14 patients) according to the initial clinical assessment by NIHSS score, radiological assessment by (MRI diffusion and diffusion perfusion mismatch), and after 1.5 months in follow up. They were 23 males and 17 females. Their ages ranged between 31 and 78 years.

As regards to correlation between patients outcome and risk factors our results showed that, in relation to site of infarction, 26 patients with good outcome (2 ICA& 4 M1 & 7 M2 & 10 M3 & 3 ACA), and 14 patients with bad outcome (3 ICA& 7 M1 & 2 M2 & 1 M3 1 ACA). In relation to hypertension, there were 13/26 good outcome and 8/14 bad outcome. In relation to smoking, there were 5/26 good outcome, 8/14 bad outcome. In relation to diabetic controlling by HbA1c, good outcome ranged 3-8, bad outcome ranged 5-11. There were high significant statistical differences between patients with good and bad outcome as regards to site of infarction, smoking, diabetic controlling by HbA1c, no significant statistical difference between patients with good and bad outcome as regards hypertension **(Table 1).**

Table (1): Comparison between patients with good -and bad outcome as regards risk factors of stroke.

Risk factor \ Outcome		Good (No.= 26)	Poor (No.= 14)	P-value
Site of infarction	**ICA**	**2 (7, 69%)**	3 (28, 57%)	**0.016**
	M1	**4 (15, 38%)**	**7 (50%)**	
	M2	**7 (27, 92%)**	**2 (14.29%)**	
	M3	**10 (38,46%)**	**1 (7.14%)**	
	ACA	**3 (11,53%)**	**1 (7.14%)**	
Hypertension	**Number**	**13/26**	**8/14**	**0.666** .
	Percent	**50.0%**	**57.14%**	
Smoking	**Number**	**5/26**	**8/14**	**0.015**
	Percent	**19.23%**	**57.14%**	
Diabetic controlling by HbA1c	**Mean ± SD**	**4.96 ± 1.56**	**7.40 ± 1.71**	**0.0001**
	Range	**3 – 8**	**5 – 11**	

ICA: Internal carotid artery. M1: First segment of middle cerebral artery

M2: Second segment of middle cerebral artery. M3: Third segment of middle cerebral artery. ACA: Anterior cerebral artery

In relation to patients outcome and radiological findings we found that infarction size by DWI, range of patients with good outcome (12 – 44) with mean ± SD (29.06 ± 8.22), range of patients with bad outcome (12.8 – 89) with mean ± SD (59.81 ± 20.41). In relations to absolute mismatch by diffusion and perfusion MRI, range of patients with good outcome (36 – 94) with mean ± SD (65.55 ± 16.00), range of patients bad outcome (75 – 190) with mean ± SD (129.75 ± 38.65).Also follow up radiology after 1.5 month, patients' with good outcome reduced 18 patients (69.23%), the same 8 patients (30.77%), patients with bad outcome reduced 4 patients (28.57%), the same 10 patients (71.43%). There was high significant statistical difference between patients with good and bad outcome as regard infarction size by DWI, Absolute mismatch by diffusion perfusion MRI and Follow up radiology after 1.5 month (**Table 2).**

Table (2): Comparison between patients with good and bad outcome as regards radiological findings by MRI.

Outcome / Radiological Finding by MRI		Good (No.= 26)	Bad (No =14)	P-value
Infarction size by DWI	**Mean ± SD**	**29.06 ± 8.22**	**59.81 ± 20.41**	**0.0001**
	Range	**12 – 44**	**12.8 – 89**	
Absolute mismatch	**Mean ± SD**	**65.55 ± 16.00**	**129.75 ± 38.65**	**0.0001**
	Range	**36 – 94**	**75 – 190**	
Follow up radiology after 1.5 month	**Reduced**	**18 (69.23%)**	**4 (28.57%)**	**0.013**
	The same	**8 (30.77%)**	**10 (71.43%)**	

DISCUSSION

Numerous clinical variables have been identified as potential predictors of clinical outcome, and severity of presenting clinical deficit are consistently found to be predictive of outcome. Infarct volume as measured by MRI diffusion, has also been shown to correlate with clinical outcome **(Natios et al., 2012).**

Advanced neuroimaging provides information about a patient's physiology that may be useful to guide treatment decisions, especially in an extended time window. Selecting patients for reperfusion therapy based on the mismatch between lesions in diffusion-weighted and perfusion images has been proposed, but this approach has been uniformly proved to predict a good or poor outcome, **(Kidwell et al., 2010).**

In our study, we have found that patient who underwent DWI with infarction size had good outcome. This was in agreement with **Schaefer et al. (2014)** who estimated pre thrombolytic infarction size of patients with good outcome.

Also, **Miran et al. (2016)** reported that MRI protocols such as DWI stroke volume, infarction core volume, and DWI ASPECTs system that measure volume in acute ischemic stroke showed high inter-reader reliability and good prediction power for clinical outcome.

In the present study, we have found that absolute diffusion perfusion mismatch, good predictors for outcomes of patients with acute ischemic stroke. This was in agreement with **Schaefer et al. (2014)** who reported the good and poor outcome groups respectively.

In the present study we found no significant difference as regard age of patients between both groups, This was in agreement with **Oh et al. (2014)** and **Schaefer et al. (2014).**

In addition, we found no significant difference in between the 2 groups as regards the sex of the patient and the outcome, this was in contrast to **Bill et al. (2013) and Oh et al. (2014)** who stated the female sex a predictive factor for bad outcome, because range of female age more than 50 years (post-menopausal) more liable for hypertension and hyperlipidemia.

A significant difference has been found as regards the stroke site. Patients with the good outcome had occlusion in the **M2 and M3** territories, those who had bad outcome had more proximal occlusion in **ICA** and **M1**, suggesting that those with proximal occlusion had bad outcome. This was in agreement with **Schaefer et al. (2014)**. Also, **Lau et al. (2013)** reported that occlusion of multiple sites of ICA detected by computed tomography angiography, and complete occlusion are independent predictors of unfavorable outcome at 6 months.

In the present study, we have found that patients with acute cerebrovascular stroke with initial NIHSS (7-9) had a favorable outcome after 45 days in comparison with those who had initial NIHSS score of 17 (15-19) for unfavorable outcome. **Schaefer et al. (2014)** estimated NIHSS of 8 for good and 20 for bad outcome patients who performed further thrombolytic therapy. Also, **Natalia et al. (2016)** reported that the base line NIHSS score was essential for prediction of acute ischemic stroke outcome.

In our study, we found a significant increase in the smoker among the group of bad outcome than those with good outcome. This suggested the long-term effect of smoking on the collaterals, but this did not agree with **Bill et al. (2013)** who do not find a significant difference as regards active smoking because this study was carried out on large number of patients and longer period than us.

In addition, we have found a significant difference between the good and bad outcome groups as regards the blood glucose control assessment by **HbA1C** levels. This was in agreement with a similar concept as regards blood glucose in the study of **Natios et al. (2012)** and **Desilles et al. (2013)** who reported that admission blood glucose level and history of uncontrolled diabetes mellitus are associated with poor clinical outcome after thrombolysis. Admission blood glucose level may be a surrogate marker of brain infarction severity rather than a causal factor. However, randomized controlled evidences are needed to address the

significance of a tight glucose control during thrombolysis on clinical outcome.

We found no significant difference in the number of the patients with history of hypertension in both good and bad outcome groups. This did not agree with **Bill et al. (2013)** who found significant difference in between the severe and non-severe stroke groups as regards the blood pressure at time of admission (24-48) hours.

We did not find a significant difference between the good and the bad groups as regards the history of cardiac disease. This was in contrast with **Bramm?s et al. (2013)** who find a significant difference as regard the cardiac disease especially acute myocardial infarction and the outcome of ischemic stroke. The increased use of evidence-based therapies (thrombolytic therapy) explains the improved prognosis.

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المآل التنبؤي لمرضي الاحتشاء المخي الحاد عن طريق الفحص الإكلينيكي والرنين المغناطيسي

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خلفية البحث: المآل للمرضى الذين يعانون من السكتة الدماغية الحادة تبني على الرنين المغناطيسي بالانتشار والتشبع وحجم الجلطة وعوامل خطر سابقة للمرض وذلك للتنبؤ بنتائج الجلطة

الهدف من هذا البحث: تقدير نتائج الجلطة المخية عن طريق الفحص الإكلينيكي ودراسة التصوير باستخدام والرنين المغناطيسي بالإنتشار والتشبع.

المرضى وطرق البحث: شملت الدراسة المرضي الذين تم حجزهم بمستشفيات جامعة الأزهر (الحسين وسيد جلال) أثناء الفترة من 1/12/2015 إلي ٢٠١٦/٧/٣٠ وتم تشخيصهم بالجلطة الدماغية الحادة وكل المرضي تم عمل لهم الفحص الإكلينيكي المبدئي وقت الحجز. وتقييم إشعاعي بعمل قياس حجم الجلطة بالرنين المغناطيسي بالإنتشار، ومعدل تطابق الرنين المغناطيسي بالإنتشار والتشبع، وكذلك متابعة بعد شهر ونصف، وتم ترتيب المرضى احصائيا.

النتائج: تم تقسيم المرضى إلي مجموعتين: المجموعة الأولى (٢٦ مريض) ذوى مآل تنبؤي جيد، والمجموعة الثانية (١٤ مريض) ذوي مآل تنبؤي سيء وذلك حسب الفحص الإكلينيكي المبدئي عند وقت الحجز، وحجم الجلطة في الرنين المغناطيسي بالإنتشار، وكانت أكثر العوامل التنبوئية لنتائج مرضى السكتة الدماغية الحادة هي: عدم إنتظام نسبة السكر بالدم، والتدخين، وموقع الجلطة بالمخ، وحجم الجلطة في الرنين المغناطيسي بالإنتشار، ونسبة عدم التطابق بالرنين المغناطيسي بالإنتشار والتشبع، والمتابعة بالرنين المغناطيسي بعد شهر ونصف توجد بينهم دلالة إحصائية موجبة.

الاستنتاج: الإنتظام بعلاج إرتفاع نسبة السكر بالدم، وإيقاف التدخين، وبعض عوامل الأيض تحسن نتائج مرضى السكتة الدماغية الحادة، والتقييم الإشعاعي لمرضي السكتة الدماغية الحادة بواسطة قياس حجم الجلطة بالرنين المغناطيسي بالإنتشار، ودرجة عدم تطابق الرنين المغناطيسي بالإنتشار والتشبع الزامي لتقييم جيد لخطورة السكتة الدماغية والتنبؤ بالنتائج.