

## Stress hyperglycemia as prognostic criteria in stroke patient

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### Abstract

#### 1-Back ground and purpose

Stress hyperglycemia may associate with increase mortality and poor functional recovery in non-diabetic patients after stroke<sup>(1)</sup>, and this study was done to clarify this relationship.

#### 2-Objective

1-To study the effect of stress hyperglycemia on prognosis and mortality in stroke patients.

2-To compare the results with normoglycemic patients and diabetic stroke patients.

3-To determine whether this stress hyperglycemia occurs more in infarction or hemorrhagic stroke.

#### 3-Method

The effect of stress hyperglycemia on prognosis and mortality in stroke Patients was studied in (50) patients who were admitted to Merjan Teaching hospital by measuring random blood glucose for each patient and assess the severity of stroke by applying Scandinavian stroke scale (SSS) For each patient also type of stroke whether hemorrhagic or infarction was studied in each patient.

#### 4- Results

A total number of 50 patients were studied, 19 (38%) were normoglycemic, 17 (34%) patients had stress hyperglycemia, and 14 (28%) were diabetic patients.

#### Group (1)

Normal patients (no history of diabetes and didn't develop hyperglycemia after stroke).

#### Group (2)

Stress hyperglycemic patients (no history of diabetes and developed hyperglycemia after stroke).

#### Group (3)

Diabetic patients (already diabetics before stroke).

(SSS) was highest in group (1) followed by group (3) and was worse in group (2) that was statistically significant.

There was no significant difference in mortality among these groups ( $P > 0.05$ ).

Also there was no significant difference between hemorrhage and infarction among three groups.

Key words: Stroke, hyperglycemia.

#### الخلاصة

الغرض:-

ارتفاع السكر الاجهادي له علاقة بزيادة نسبة الوفاة وضعف في العودة الى الوضع الوظيفي في الاشخاص غير المصابين بداء السكري بعد الطارئة الوعائية الدماغية. وهذا البحث قد انجز لتوضيح هذه العلاقة.

الاهداف:-

- 1- لدراسة تأثير ارتفاع السكر الاجهادي على الاتجاهات المحتملة التي يتخذها المرض والوفاة للمصابين بالطارئة الوعائية الدماغية.
  - 2- لمقارنة النتائج مع الاشخاص الذين تكون نسبة السكر في الدم لديهم طبيعية مع الذين لديهم زيادة في نسبة السكر في الدم.
  - 3- لتحديد في ما اذا كان ارتفاع السكر الاجهادي يحدث اكثر لدى المصابين بالطارئة الوعائية الدماغية الناتجة عن النزف او التجلط.
- الطريقة:- تأثير ارتفاع السكر الاجهادي على الاتجاهات المحتملة التي يتخذها المرض والوفاة للمصابين بالطارئة الوعائية الدماغية قد درست في ( 50 ) مريضاً أدخلوا الى مستشفى مرجان التعليمي واذلك بقياس نسبة السكر في الدم لكل مريض وتحديد شدة الطارئة الوعائية الدماغية بتطبيق مقياس الطارئة الوعائية الدماغية الاسكندنافي ( SSS ) لكل مريض اضافة الى تحديد الطارئة الوعائية الدماغية فيما اذا كانت ناتجة عن نزف او تجلط.
- النتائج:- العدد الكلي للمرضى الذين شملتهم الدراسة هو ( 50 ) مريضاً. ( 19 ) مريضاً ( 38 % ) كانت نسبة السكر لديهم طبيعية. و ( 17 ) مريضاً ( 34 % ) حدث لهم ارتفاع السكر الاجهادي و ( 14 ) مريضاً ( 28 % ) كانوا مصابين بداء السكر قبل الطارئة الوعائية الدماغية.
- المجموعة الاولى: مرضى ليس لديهم اصابة بداء السكر قبل الطارئة الوعائية الدماغية ولم ترتفع عندهم نسبة السكر في الدم بعدها.
- المجموعة الثانية: مرضى ليس لديهم اصابة بداء السكر قبل الطارئة الوعائية الدماغية وارتفع عندهم السكر في الدم بعدها.
- المجموعة الثالثة: مرضى لديهم اصابة بداء السكر قبل الطارئة الوعائية الدماغية.
- مقياس الطارئة الوعائية الدماغية الاسكندنافي ( SSS ): كان اعلى في المجموعة الاولى تبعته المجموعة الثالثة وكانت نسبته الاقل في المجموعة الثانية وهذه النتائج كانت ذات قيمة احصائية.
- لم تكن هناك قيمة احصائية في نسبة الوفيات بين المجاميع الثلاثة، وكذلك لم تكن هناك قيمة احصائية في كون الطارئة الوعائية الدماغية ناتجة عن نزف او تجلط بين المجاميع الثلاثة.

## **Introduction**

-Stroke is the third most common cause of death in developed world after cancer and ischemic heart disease, and is responsible for a large proportion of physical disability, becoming more frequent with increasing age. Hyperglycemia is considered as an important risk factor of stroke<sup>(2)</sup>.

In some people in whom an oral glucose tolerance test is normal, an abnormal results are observed under conditions which impose a burden on the pancreatic beta cell, e .g during infection, myocardial infarction, stroke or other stresses, this is known as “stress hyperglycemia”.<sup>(2)</sup>

A high proportion of patients suffering an acute stress such as stroke<sup>(3)</sup> or myocardial infarction<sup>(4)</sup> may develop hyperglycemia, even in the absence of a preexisting diagnosis of diabetes mellitus, Both human and animal studies suggest that this is not a benign occurrence and that stress-induced hyperglycemia is associated with a high risk of mortality after both stroke<sup>(5)</sup> and myocardial infarction<sup>(6)</sup>. Moreover, recent evidence that glucose lowering with insulin reduces ischemic brain damage in animal models of stroke<sup>(7)</sup> suggests that stress-induced hyperglycemia may be modifiable risk factor for brain damage.

Despite these observations, the relationship between glucose levels and outcome after stroke in diabetic and non diabetic patients has not been well characterized, and those studies that have studied this relationship have reported conflicting results , so the aim of this study is to estimate the strength of the association between stress hyperglycemia and both short term mortality and functional recovery after stroke.

## **Patients and methods**

A total number of 50 patients with stroke of both sexes were studied over a period of 4 months (from June 2004 to October 2004 ) in Merjan teaching hospital , one patient referred to the neurosurgical hospital , three patients left the hospital against medical advices , 11 patients died .

Details about previous history of diabetes were taken from each patient and full neurological assessment was done for each one.

These patients were divided into (3) groups:

Group (1)

Patients with no history of diabetes and didn't develop hyperglycemia after stroke.

Group (2)

Patients with no history of diabetes before stroke and then developed hyperglycemia after stroke (stress hyperglycemia).

Group (3)

Patients already diabetics.

Random blood sugar was measured for each patient at the first day of stroke, 3 rd, 7 th and 10 th days, patients considered hyperglycemic when blood sugar was more than 11mmol/L<sup>(1)</sup> for fasting blood sugar can not be practically applied in these patients . All patients in group (2) were sent for glycosylated Hb and patients whom results were above 9% (three patients) were excluded from the study for there is possibility that they were already diabetics and they don't know.

CT-scan was done for all patients to identify the type of stroke whether hemorrhagic or infarction.

Scandinavian stroke scale (SSS) was applied for each patient in 1 st , 3 rd 7 th and 10 th day to asses the severity of stroke ,if score increases that's mean good functional recovery and if decreases that's mean poor functional recovery , as shown in (Tab. 1)

Chi-square was used for statistical analysis and the results considered significant when P-value < (0.05).

Stroke Scales & Clinical Assessment Tools	
Scandinavian stroke scale Function	score
Consciousness:	
-fully conscious	6
-somnolent, can be awaked full consciousness	4
-reacts to verbal command, s not fully conscious	2
Eye movement:	
- no gaze palsy	4
-gaze palsy present	2
-conjugate eye deviation	0
Arm, motor power:	
-raises arm with normal strength	6
-raises arm with reduced strength	5
-raises arm with flexion in elbow	4
-can move, but not against gravity	2
-paralysis	0
Hand, motor power:	
-normal strength	6
-reduced strength in full range	4
-some movement, fingertips do not reach palm	2
-paralysis	0
Leg, motor power:	
-normal strength	6
-raises straight leg with reduced strength	5
-arises leg with flexion of knee	4
-can move, but not against gravity	2
-paralysis	0
Orientation:	
-correct for time, place and person	6
-two of these	4
-one of these	2
-completely disorientated	0
Speech:	
-no aphasia	10
-limited vocabulary or incoherent speech	6
-more than yes/no, but not longer sentences	3
-only yes/no or less	0
Facial palsy:	
-none/dubious	2
-present	0
Gait:	
-walks 5 m without aids	12
- walks with aids	9
- walks with help of another person	6

- sits without support	3
-bedridden/wheelchair	0

\* Motor power is assessed only on the affected side.

### Table 1

### Results

50 patients were studied, 29 males (58%) aged (43-85) years and 21 females (42%) aged (46-82) years divided into 3 groups:-

- 1) Group (1) number of patients 19 (38 %), 10 males and 9 females age (50-81) years.
- 2) Group (2) number of patients 17(34%), 11 males and 6 females age (46-85) years.
- 3) Group (3) number of patients 14(28 %), 9 males and 5 females age (43-78) years.

Blood sugar:-

In group (1) the blood sugar remained within normal range from 1st to last day.

While the patients who were included in group (2) showed that all of them had elevated blood sugar in the 1st day while 2 out of 17 (11%) of them had normal blood sugar in 3rd day, while in 7th day 5 out of 17 (29%) showed normal Blood sugar and in 10th day 8 of 17 patients (47%) returned to normal blood sugar and all of them were treated with insulin.

Patients in group (3) showed elevated blood sugar in 1st day and then decreased gradually with subsequent days (all of them were treated with insulin) as shown in table (2).

Mortality:-

There were 3 patients out of 19 (15%) of group (1) who died while 5 out of 17 patients (29%) were died in group (2) (  $P > 0.05$  which is statistically not significant ) while 3 out of 14 (21%) in group (3) were died and when compared with group (2) showed statistically not significant (  $P > 0.05$  ), as shown in table (3)

Ct-scan:-

There were 12 out of 19 (63%) had infarction in group (1) while there were 7 out of 19 (37%) had hemorrhagic stroke.

While in group (2) there were 11 out of 17 (65%) had infarction, and 6 out of 17 (35%) had hemorrhage.

In group (3) 9 out of 14 (65%) had infarction and 5 out of 14 (35%) had hemorrhage. These results were statistically not significant as (  $P > 0.05$  ) when group (2) was compared with group (1) and group (3). As shown table (4).

(SSS):-

For those with group (1) patients the score of (SSS) showed increased figures gradually from 1st day to the last day.

In group (2) the score lowered gradually (statistically significant when compared with group 1) (  $P < 0.05$  ).

While in group (3) patients showed gradual decreasing score, but this was less in comparison with group (2) (statistically significant when compared with group 2). As shown in table (5).

The level of blood glucose in group 1, group 2 and group 3

Groups	Mean 1 <sup>st</sup> day	Mean 3 <sup>rd</sup> day	Mean 7 <sup>th</sup> day	Mean 10 <sup>th</sup> day
Group 1	5.5 ± 2.0	5.3 ± 1.9	5.0 ± 1.7	5.1 ± 1.8
Group 2	13.1 ± 1.3	12.1 ± 1.1	11.5 ± 0.9	10.5 ± 0.8
Group 3	15.5 ± 1.5	14 ± 1.3	12.2 ± 0.9	11.2 ± 0.9

Table (2 )

Percentage of death in group 1, group 2 and group3  
(P> 0.05)

groups	Total number	Death	%
Group 1	19	3	15.78
Group 2	17	5	29.41
Group 3	14	3	21.42

(3)

Table

Percentage of infarction and hemorrhage in group 1, group 2 and group 3  
(P> 0.05)

groups	infarction	%	hemorrhage	%
Group 1	12	63	7	37
Group 2	11	65	6	35
Group 3	9	65	5	35

Table (4)

Severity of Stroke ( SSS ) in group 1 , Group 2 , and Group 3  
(P < 0.05)

Groups	Mean 1st. day	Mean 3 rd. day	Mean 7 th. day	Mean10th. day
Group 1	38 ± 6	40 ± 5	41 ± 6	42 ± 8
Group 2	25 ± 5	23 ± 6	23 ± 4	20 ± 4
Group 3	29 ± 5	28 ± 8	27 ± 4	26 ± 5

Table ( 5 )

## **Discussion**

There are multiple explanations for the effect of acute (stress hyperglycemia) on prognosis of stroke. Hyperglycemic patients are deficient in insulin amount and this result in increase amount of glucose in brain and increase level of fatty acids and this fatty acids may impair endothelial-dependant vasodilatation<sup>(8)</sup>.

Other explanation in such study on animals shows hyperglycemic stroke increases cellular acidosis in ischemic penumbra and resulting in increase volume of infarction while this occurs less when treated with insulin<sup>(9)</sup>.

Hyperglycemia also increases amount of lactate and increases intracellular acidosis in infarcted area (an aerobic glucose metabolism)<sup>(10)</sup> and this may enhance lipid peroxidation and free radical formation<sup>(11)</sup> and this permit accumulation of intracellular (calcium)<sup>(12)</sup> and also impairment of mitochondria function<sup>(9)</sup> these neuro toxic effect may be important particularly in the ischemic penumbra (the region of brain tissue surrounding the core of infarcted tissue where neuron injured but still viable).<sup>(13,2)</sup>

This study obviated that stress hyperglycemia was associated with poor functional recovery and this is consistent with other study<sup>(1)</sup> (stress hyperglycemia associated with increase risk of mortality and poor functional recovery) and also met agreement with other study<sup>(14)</sup> (hyperglycemia play a role on the outcome of acute ischemic stroke patients).

In this study the percentage of mortality in stress hyperglycemia was higher than other groups but it was statistically not significant probably related to the limited number of patients or the short period of follow up but it showed that (SSS) is significantly lower in stress hyperglycemia reflecting more sever illness.

This study showed that both hemorrhagic and ischemic stroke had no significant difference in the induction of hyperglycemia , although other study showed increased association of stress hyper glycemia with infarction stroke<sup>(1)</sup>.

## **Conclusion**

- 1- Stress hyperglycemia is associated with lower SSS in stroke patients and thus it is associated with poor functional recovery.
- 2- Stress hyperglycemia occur in both hemorrhagic and infarction stroke with out statistically different results .

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