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Correlation of HbA1c Levels with Clinical Profile and Infarct Size in Patients with Acute Ischemic Stroke

K.R Madhu[1*], S S Devarmani[2], Vijay Kumar Warad[3], S G Balaganur[4], Ravi Kattimani[5]
[1]Post Graduate, Department of General Medicine, Shri B.M.Patil Medical College, Vijayapura, Karnataka, India
[2]Professor, Department of General Medicine, Shri B.M.Patil Medical College, Vijayapura, Karnataka, India
[3]Professor, Department of General Medicine, Shri B.M.Patil Medical College, Vijayapura, Karnataka, India
[4]Associate professor, Department of General Medicine, Shri B.M.Patil Medical College, Vijayapura, Karnataka, India
[5]Senior residents, Department of General Medicine, Shri B.M.Patil Medical college, Vijayapura, Karnataka, India

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***Corresponding author**
K.R Madhu

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Abstract: Stroke is the second leading causes of death worldwide and one of the leading causes of disability. The most common cause of stroke is represented by cerebral ischemia and approximately 80% of strokes are due to ischemic cerebral infarction and 20% due to brain hemorrhage. Diabetes Mellitus is an independent risk factor for stroke and is associated with 2 to 6 fold increased risk compared with non-diabetic subjects and worsens survival of patients with acute stroke. To correlate the HbA1C levels with clinical profile and infarct size in patients with acute ischemic stroke. This Cross sectional study was conducted in the Department of Medicine, Shri B M Patil medical college hospital and research centre, Vijayapura in patients with acute ischemic stroke. A study design consists of 64 diabetic patients. Age >18 years and patients with Acute ischemic stroke has been included in this study. Maximum number of patients was in the age group of 60 – 69 years, with mean age of 63.59±12.59 years. There were 25 patients (39.1%) well controlled Diabetes patients, 16(25.0%) fairly controlled and 23 (35.9%) were poorly controlled Diabetic patients. Progressive increase in the NIHSS score from well controlled diabetes to poorly controlled diabetes. The NIHSS score increased as the infarct size increased from well controlled to poorly controlled diabetes. Increased severity of stroke is seen in poorly controlled diabetes which correlates with the infarct size. HbA1c levels, NIHSS score correlates well with the infarct size. Severity of the stroke worsened from well controlled diabetes to poorly controlled diabetes.HbA1c should be considered as an independent risk factor for poor clinical outcome and worse prognosis,
Keywords: HbA1C, Infract size, NIHSS.

INTRODUCTION

Stroke is the second leading causes of death worldwide and one of the leading causes of disability. The most common cause of stroke is represented by cerebral ischemia and approximately 80% of strokes are due to ischemic cerebral infarction and 20% due to brain haemorrhage [1]. Cerebrovascular disorders are increasing in prevalence and incidence in India due to rapid escalation of risk factors including Hypertension, Diabetes Mellitus, Smoking and obesity affecting considerable proportion of adult population**.** The combination stroke and Diabetes Mellitus is associated with worse stroke related outcome, high disability and stroke recurrence. Approximately 20% of patients with Diabetes die from stroke [2].

The incidence of stroke increases as the age progresses and the number of stroke patients is projected to increase in elderly population. Stroke is more commonly seen in Males when compared to females [3]. The mechanism is believed to be accelerated atherosclerosis, which can affect vessels in many distributions, including small and large vessels [4].

Glucose intolerance in a stroke patient may or may not reflect glycemia prior to the event. Hence, measurement of HbA1C rather than glucose as an indicator of prior glycemia offers a new perspective. The rate of non-enzymic glycosylation of haemoglobin is believed to depend largely or solely on plasma glucose concentration [5].

MATERIALS AND METHODS

It is Hospital based cross sectional study. Information was collected through prepared proforma for each patient.

With the proportion of stroke 50% at 95%confidence interval & 5%precesion calculated sample size is 64.

It is known that Ischemic stroke accounts for 80%of the Stroke [6].

$$n = \frac{Z^2 * p * (1-p)}{e^2}$$

Z - Z value at 95% Confidence interval.
P - Proportion rate.
E - Margin of error.

Hence 64 Ischemic stroke cases will be included in the study.

Statistical analysis

Data will be analysed by

- Mean +_SD
- Students t test/ Mann whitney U test
- Correlation coefficient

Inclusion Criteria

- All male and female cases of acute ischemic stroke.
- Patients of age more than 18yrs.

Exclusion Criteria

- Patients of age less than 18yrs.
- Haemorrhagic stroke.
- Transient ischemic attacks.
- Subdural/Epidural haematomas

Study design

1. Estimation of Random blood glucose and HbA1c levels were done at the time of admission.
2. Patients were scored severity based on NIH stroke scale at the time of admission.
3. Hba1c levels <6% indicates well controlled,6-9% indicates fairly controlled,>9% indicates poorly controlled.
4. Infarct size on CT/MRI scan brain <3cm^2 is small,3-5cm^2 is moderate and >5cm^2 is large infarct.
5. NIHSS score 0-4 indicates minor stroke; 5-15 indicates mild to moderate, 16-20 indicates severe and 21-42 indicates very severe neurologic impairment.

RESULTS

Sixty four patients with cerebral infarction admitted to Shri B.M. Patil Medical College Hospital who met the inclusion criteria were included in the study. The age group of the patients ranged from 35- 90 years with mean age of 63.59±12.55 .The mean NIHSS score is 19.55 ± 7.71 and mean HbA1c is 7.67±2.27 (Table1).The maximum number of patients was in the group of 60 – 69 years. There were 37 (57.8%) male patients and 27 (42.2 %) female patients with male: female ratio of 1.37: 1.

Table-1: Descriptive stastistics

X	Minimum	Maximum	Mean	Std. Deviation
Age	35	90	63.59	12.558
Nihss score	8	35	19.55	7.719
Blood glucose on admission	80	420	212.23	88.907
HbA1C	4.50	12.80	7.6766	2.27594

Out of 64 diabetic patients, 25 patients (39.1%) were well controlled, 16(25.0%) patients were fairly controlled and 23 patients (35.9%) were poorly controlled. In this study Diabetic status is classified based on the HbA1C levels. HbA1c <6 is well controlled, 6 – 9 to fairly controlled and >9 is poorly controlled.

The size of the infarcts on CT/MRI scans were classified as small <3cm^2, medium 3 – 5 cm^2, and large >5cm^2. In this study, 25 (39.1%) patients have small sized infarcts, 13 (20.3%) patients have medium sized infarcts and 26(40.6 %) patients have large sized infarcts.

The clinical severity of stroke was measured using the NIHSS score on admission. Minor stroke is 0-4, moderate stroke 5-15, moderate to severe stroke 16 to 20, severe stroke 21-42.

Table-2: Association between hba1c and nihss

HbA1C vs NIHSSscore	Moderate Stroke	Moderate to Severe	Severe Stroke	Total	Chi square test
<6	24(100%)	1(7.1%)	0(0)	25(39.1%)	P=0.0001*
6-9	0(0)	13(92.9%)	3(11.5)	16(25.0%)	
9+	0(0)	0(0)	23(35.9%)	23(35.9%)	
Total	24(100%)	14(100%)	26(100%)	64(100%)	

In this study 24 (96%) patients with well controlled Diabetes had moderate stroke severity, 13 (81.2%) patients with fairly controlled Diabetes had moderate to severe stroke severity and 23(100%) patients with poorly controlled Diabetes had severe stroke (Table2).

In this study well controlled Diabetes has moderate stroke severity, fairly controlled Diabetes has moderate to severe stroke severity and poorly controlled Diabetes has severe stroke. It is observed that severity of the presenting complaints worsened from well controlled Diabetes to poorly controlled Diabetes. The NIHSS score correlates with the HbA1C, with increase in severity of the stroke from well controlled Diabetes to poorly controlled Diabetes with p value of 0.0001.

Most of the small sized infarcts occurred in the well-controlled Diabetes group, medium sized infarcts in fairly controlled Diabetes and most of the large sized infarcts in the diabetes group.In the well-controlled Diabetes group, 96% have small sized infarcts and 4% have medium sized infarcts. There were no large sized infarcts. In the fairly controlled Diabetes group, 6.2% have small sized infarcts, 75% of patients have medium sized infarcts and 18.8 % of patients have large sized infarcts. In poorly controlled Diabetes group, 100% of patients have large sized infarcts (Table3).

Table-3: Association between hba1c and infarct size

HbA1C vs Infarct size	<3 cm^2	3-5 cm^2	>5 cm^2	Total	Chi square test
<6	24(96%)	1(7.7%)	0(0)	25(39.1%)	P=0.0001*
6-9	1(4)	12(92.3%)	3(11.5)	16(25.0%)	
9>	0(0)	0(0)	23(88.5%)	23(35.9%)	
Total	25(100%)	13(100%)	26(100%)	64(100%)	

In this study it is observed that, NIHSS score is lowest in the well-controlled Diabetes. Severity of the score increases as the infarct size increases (Table4).

Poorly controlled Diabetes has more severe stroke as per NIHSS score with large sized infarcts (figure1).

Table-4: Association between infarct size and nihss

Infract size Vs NIHSS	Moderate Stroke	Moderate to Severe	Severe Stroke	Total	Chi square test
<3	24(100%)	1(7.1%)	0(0)	25(39.1%)	P=0.0001*
3-5	0(0)	12(85.7%)	1(3.8)	16(25.0%)	
5+	0(0)	1(7.1)	25(96.2%)	23(35.9%)	
Total	24(100%)	14(100%)	26(100%)	64(100%)	

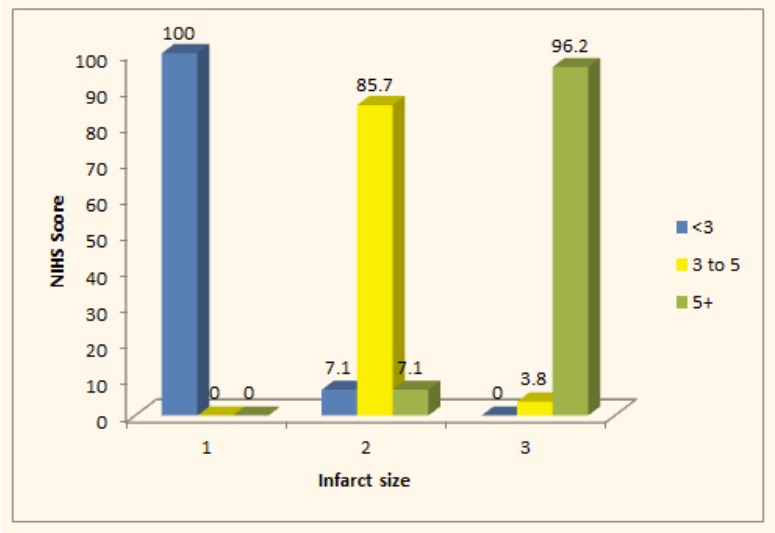

Fig-1: Association between infarct size and nihss

DISCUSSION

Diabetes is an independent risk factor for atherothrombotic brain infarction. As increased HbA1c level reflects poor long term glycemic control and has its specific implications on the structure and function of vascular bed including small as well as large cerebral vessels. Increased HbA1c level might also be a marker of poor compliance indicating an unhealthy life style [7].

There were 37 (57.8%) male patients and 27 (42.2 %) female patients with male: female ratio of

1.37: 1. Even Hyvarinen M *et al*. study reported that there is male preponderance with of 55% men and 45 % women out of 21706 cases [8].

Out of 64 diabetic patients, 25 patients (39.1%) were well controlled,16(25.0%) patients were fairly controlled and 23 patients (35.9%) were poorly controlled. In this study Diabetic status is classified based on the HbA1C levels. HbA1c <6 is well controlled, 6 – 9 is fairly controlled and >9 is poorly controlled.

In this study, the common risk factors were Diabetes, Hypertension, and smoking, Dyslipidaemia, Rheumatic heart disease and retroviral disease. Diabetes, Hypertension, smoking were the commonest risk factors. These risk factors are comparable to other studies in stroke [9, 10].

The size of the infarcts on CT/MRI scans were classified as small <3cm^2, medium 3 – 5 cm^2, and large >5cm^2.In this study, 25 (39.1%) patients have small sized infarcts, 13 (20.3%) patients have medium sized infarcts and 26(40.6 %) patients have large sized infarcts. In the well-controlled Diabetes group 24 (96%) have small sized infarcts and 1(4%) have medium sized infarcts. There were no large sized infarcts. In the fairly controlled Diabetes group 1(6.2%) have small sized infarcts, 12 (75%) of patients have medium sized infarcts and 3 (18.8 %) of patients have large sized infarcts. In poorly controlled Diabetes group, 23(100%) of patients have large sized infarcts. R. Chen *et al*. noted that increase in the infarct size with poorly controlled diabetes and thus poor prognosis [11]. Thus the fairly controlled diabetes patients have higher percentage of medium sized infarcts and poorly controlled diabetes patients have large sized infarcts. There is increase in the infarct size with worsening of the glycemic status. The clinical severity of stroke was measured using the NIHSS score on admission. Minor stroke is 0-4, moderate stroke 5-15, moderate to severe stroke 16 to 20, severe stroke 21-42. In this study 24 (96%) patients with well controlled Diabetes had moderate stroke severity, 13 (81.2%) patients with fairly controlled Diabetes had moderate to severe stroke severity and 23(100%) patients with poorly controlled Diabetes had severe stroke.

Hjalmarsson *et al*. study suggests that poor glycemic control (baseline HbA1c) prior to ischemic stroke is an independent risk factor for poor survival and a marker for increased stroke severity and unfavourable long-term functional outcome [12]. Johnston *et al*. noted that infarct volume significantly predicted NIHSS score on admission [13].

Kamouchi *et al*. who studied 3627 patients, the result showed that neurological improvement is lower relevant to age and sex and is higher relevant to the blood HbA1C levels on admission[14].

Toumilehto j *et al*. study proved that Diabetes mellitus was the strongest risk factor for death from stroke among both men and women.Men with diabetes at baseline appeared to be at a six fold increased risk of death from stroke [15].

The small sample size and not including the area of infarction,cross sectional study with no follow up are the limitations of the study.

CONCLUSION

HbA1c levels, NIHSS score correlates well with the infarct size. Patients with poorly controlled diabetes were found to have increased NIHSS score and increased severity of stroke. Severity of the stroke worsened from well controlled diabetes to poorly controlled diabetes.HbA1c should be considered as an independent risk factor for poor clinical outcome and worse prognosis. Early diagnosis and treatment of diabetes including lifestyle modification and periodic monitoring of HbA1c levels may reduce the development of stroke and morbidity and mortality associated with it.

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