

## THE GLYCEMIC STATUS IN STROKE

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### ABSTRACT

The study was done to know the short-term prognosis in stroke patients either ischemic stroke or primary intracerebral hemorrhage in diabetics and euglycemics. 80 stroke patients confirmed by CT scan of head, who fulfilled the inclusion and exclusion criteria were enrolled in the study. Their glycemetic status was investigated and grouped under four headings namely; known diabetic, freshly detected diabetic, stress hyperglycemia and euglycemic. These patients were followed up for 7 days and their prognosis was grouped under four headings namely; expired, no recovery, partial recovery and complete recovery.

Majority of the patients were in the age group of 60-69 years. There were 58 males and 22 females. 62.5% of patients were euglycemics, 21.25% known diabetic, 8.75% freshly detected diabetic and 7.5% had stress hyperglycemia. Freshly detected diabetics had higher prevalence of ischemic infarct (85.7%) and known diabetics and euglycemics had comparable prevalence of ischemic infarct (70.6% and 66% respectively). All stress hyperglycemic patients had hemorrhagic stroke with 100% mortality. Both known diabetic and freshly detected diabetic are associated with higher mortality rate than euglycemics (41%, 43% and 14% respectively). As compared to euglycemics, the mortality was significantly higher in known diabetics ( $p < 0.05$ ) and stress hyperglycemics ( $p < 0.001$ ). Though mortality was also higher in freshly detected diabetics, it was statistically not significant ( $p > 0.05$ ). Both known diabetic and freshly detected diabetic patients with stroke are associated with higher percentage poor outcome during 7 days follow-up than the euglycemics (82.35%, 100% and 36%).

### KEY WORDS

Glycemia; stroke; outcome.

### INTRODUCTION

Cerebrovascular accident (CVA) or stroke is the most common life threatening neurological disorder. It ranks foremost among all the disorders of central nervous system and is the third leading cause of death after cardiovascular disease and cancer.<sup>1</sup> Cerebral infarction is responsible for about 80% of all first ever in a life-time strokes. Primary intracerebral hemorrhage (PICH) for 10% and subarachnoid hemorrhage for 5%.

The incidence of stroke worldwide is 179 per 1,00,000 population. In India, it varies from 50 to 842 per 1,00,000 in various parts. In Western countries overall prevalence rate is 794/1,00,000 population. "Abrupt onset of a non-convulsive and focal neurological deficit lasting more than 24 hours is referred to as stroke".

Diabetes mellitus is one of the well established major risk factors for stroke apart from hypertension, ischemic heart disease, hyperlipidemia, alcoholism, smoking and family history.<sup>2</sup> In this communication, I propose

to present my observation in regard to “Glycemic status in stroke patients and its prognostic value in 80 cases, admitted in Basaveshwar Teaching & General Hospital and Government General Hospital, Gulbarga during the period from March 2002 to February 2004”. Study is done with a follow-up of only 7 days to know the early mortality, morbidity and recovery in acute stroke.

### AIMS & OBJECTIVES

- To study the glycemic status in stroke patients
- To relate the short-term prognosis of these patients depending on their glycemic status at the time of stroke.

### MATERIALS AND METHODS

Eighty patients of stroke admitted in Basaveshwar Teaching & General Hospital and Government General Hospital, Gulbarga between April 2002 to January 2004 were included in the study. Each patient with history and clinical examination suggestive of stroke was further investigated with CT scan of the head.

#### Inclusion Criteria:

- Stroke patients (thrombotic or primary intracerebral hemorrhage) confirmed by CT scan of head admitted with or without proven diabetes.

#### Exclusion Criteria:

- Patients with transient ischemic attack.
- Past history of stroke or with residual weakness on clinical examination due to old stroke or an old infarct/ hemorrhage on CT scan of the head.

Urine sugar, random blood sugar (RBS) and glycosylated hemoglobin were estimated for

every patient on admission. On next day fasting plasma glucose (FPG) and post prandial plasma glucose (PPPG) at 2 hours was done wherever possible.

The considered hyperglycemic ranges were:

RBS > 200 mg/dL

FPG > 126 mg/dL

PPPG > 200 mg/dL

Glycosylated hemoglobin value of more than 8% was considered as in diabetes range.

The patients were classified into:

**Euglycemic:** With normal RBS, FBS, PPBS and glycosylated hemoglobin percentage.

**Known diabetic:** Those with past history of diabetes.

#### Newly detected diabetes:

RBS > 200 mg/dL and/ or

FPG > 126 mg/dL and/ or

PPPG > 200 mg/dL

With glycosylated hemoglobin >8%

Without history of diabetes.

#### Stress Hyperglycemia:

RBS > 200 mg/dL with glycosylated hemoglobin <8%.

A follow up of these patients was done for 7 days to know their prognosis under four categories.

- Complete recovery
- Partial recovery
- No recovery
- Death.

### OBSERVATION AND RESULTS

In the present study 80 cases of who met inclusion and exclusion criteria were analyzed with regards to the glycemic status and were correlated with outcome.

**Table No. 1 Age of the individual**

Age Group (Years)	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
30 – 39	4	5.00	0	0	3	1
40 – 49	14	17.50	3	4	6	1
50 – 59	23	28.75	5	9	7	2
60 – 69	28	35.00	9	6	10	3
70 – 79	8	10.00	5	2	1	0
80 – 89	2	2.50	0	1	1	0
90 – 99	1	1.25	1	0	0	0

The patients were grouped into the following age groups as shown above.

In 4 patients (5%) between 30-39 years of age, 3 patients had partial recovery and 1 patient had complete recovery. In 14 patients (17.5%) between 40-49 years of age, 3 patients expired, 4 patients had no recovery, 6 patients had partial recovery and 1 patient had complete recovery. In 23 patients (28.75%) between 50-59 years of age, 5 patients expired, 9 patients had no recovery, 7 patients had partial recovery and 2

patients had complete recovery. In 28 patients (35%) between 60-69 years of age, 9 patients expired, 6 patients had no recovery, 10 patients had partial recovery and 3 patients had complete recovery. In 8 patients (10%) between 70-79 years of age, 5 patients expired, 2 patients had no recovery and 1 patient had partial recovery. In 2 patients (2.5%) between 80-89 years of age, 1 patient had no recovery and 1 patient had partial recovery. 1 patient (1.25%) was between 90-99 years of age and he expired.

**Table No. 2 sex of the individual**

Sex	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
Male	58	72.50	16	17	22	3
Female	22	27.50	7	5	6	4

Of the 80 patients, 58 patients (72.5%) were male and 22 patients (27.5%) were female. Of the 58 male patients, 16 expired, 17 had no recovery, 22 had partial recovery and 3 had

complete recovery. Of the 22 female patients, 7 expired, 5 had no recovery, 6 had partial recovery and 4 had complete recovery.

**Table No. 3 Type of stroke**

Type	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
Infarct	51	63.75	9	11	24	7
Hemorrhage	29	36.25	14	11	4	0

Of the 80 patients, 51 patients (63.75%) had infarct and 29 patients (36.25%) had hemorrhage. Of the 51 patients with infarct, 9 patients expired, 11 had no recovery, 24 had

partial recovery and 7 had complete recovery. Of the 29 patients with hemorrhage, 14 expired, 11 had no recovery and 4 had partial recovery.

**Table No.4 Glycemic Status of Stroke Patients**

Glycemic status	No. of Patients	Percentage
Known diabetic	17	21.25
Freshly detected diabetic	07	8.75
Stress hyperglycemia	06	7.50
Euglycemic	50	62.50

Of the 80 cases, 17 patients (21.25%) were known diabetic, 07 patients (8.75%) were freshly detected diabetic, 06 patients (7.5%) were of

stress hyperglycemia and 50 patients (62.5%) were euglycemic.

**Table No.5 Prognosis in Known Diabetic Patients**

Type of stroke	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
Infarct	12	70.60	5 (41.6%)	5 (41.6%)	2 (16.8%)	0 (0.0%)
Hemorrhage	5	29.40	2 (40.0%)	2 (40.0%)	1 (20.0%)	0 (0.0%)
<b>Total</b>	<b>17</b>		<b>7</b>	<b>7</b>	<b>3</b>	<b>0</b>

Of the 17 known diabetic patients, 12 (70.6%) had ischemic infarct and 5 (29.4%) had hemorrhage. Of the 12 known diabetic patients with ischemic infarct, 5 (41.6%) expired, 5 (41.6%) had no recovery and 2 (16.8%) had partial recovery. Of the 5 known diabetic

patients with hemorrhage, 2 (40%) expired, 2 (40%) had no recovery and 1 (20%) had partial recovery. No known diabetic patient with either ischemic infarct or hemorrhage had complete recovery. In other words, of the 7 patients expired, 5 had ischemic infarct and 2

had hemorrhage. Of the 7 patients with no recovery, 5 had ischemic infarct and 2 had hemorrhage and of the 3 patients with partial

recovery 2 had ischemic infarct and 1 had hemorrhage.

**Table No. 6 Freshly Detected Diabetic:**

Type	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
Infarct	6	(85.7%)	3 (50.0%)	3 (50%)	0 (0.0%)	0 (0.0%)
Hemorrhage	1	(14.3%)	0 (0.0%)	1 (100%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	<b>7</b>		<b>3</b>	<b>4</b>	<b>0</b>	<b>0</b>

Of the 7 freshly detected diabetic patients, 6 (85.7%) had ischemic infarct and 1 (14.3%) had hemorrhage. Of the freshly detected diabetic patients with ischemic infarct 3 (50%) expired and 3 (50%) had no recovery. 1 patient of freshly detected diabetic patient with hemorrhage had

no recovery. No patient in this group had either partial or complete recovery. In other words, of the 3 expired, all had ischemic infarct and of the 4 with no recovery, 3 had ischemic infarct and 1 had hemorrhage.

**Table No. 7 Stress Hyperglycemia**

Type of stroke	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
Infarct	0	(0.00%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Hemorrhage	6	(100%)	6 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	<b>6</b>		<b>6</b>	<b>0</b>	<b>0</b>	<b>0</b>

Of the 6 patients in stress hyperglycemia group, all had hemorrhagic stroke and all (100%) of them expired.

**Table No. 8 Euglycemia:**

Type of stroke	Total	Percent	Expired	No recovery	Partial recovery	Complete recovery
Infarct	33	(66.0%)	1 (3.0%)	4 (12.0%)	21 (63.8%)	7 (21.2%)
Hemorrhage	17	(34.0%)	6 (35.3%)	7 (41.2%)	4 (23.5%)	0 (0.0%)
<b>Total</b>	<b>50</b>		<b>7</b>	<b>11</b>	<b>25</b>	<b>7</b>

Of the 50 patients with euglycemia, 33 (66%) had ischemic infarct and 17 (34%) had hemorrhage. Of these 33 patients with infarct, 1 (3%) expired, 4 (12%) had no recovery, 21 (63.8%) had partial recovery and 7 (21.2%) had complete recovery. Of the above 17 patients with hemorrhage, 6 (35.3%) expired, 7 (41.2%) had no recovery and 4 (23.5%) had partial recovery. In other words, of

the 7 patients expired in this group, 1 had ischemic infarct and 6 had hemorrhage. Of the 11 patients with no recovery, 4 had ischemic infarct and 7 had hemorrhage. Of the 25 patients with partial recovery 21 had ischemic infarct and 4 had hemorrhage. All 7 patients of complete recovery had ischemic infarct.

**Table No. 9 Mortality in Stroke Patients with Different Glycemic Status**

Glycemic status	Expired	Survived	Total
Known diabetic	07 (41%)	10 (59%)	17
Freshly detected diabetic	03 (43%)	04 (57%)	07
Stress hyperglycemic	06 (100%)	0 (0.0%)	06
Euglycemic	07 (14%)	43 (86%)	50
Total	23	57	80

$$\chi^2 = 34.97 (p < 0.001)$$

Mortality in stroke patients with different glycemic status is statistically significant ( $p < 0.001$ ). Of the 80 patients in the study, 23

patients expired, 7 were in known diabetic group, 3 were freshly detected diabetic, 6 were of stress hyperglycemia and 7 were euglycemic.

**Table No. 10 Known diabetics Vs Euglycemic**

Glycemic status	Expired	Survived	Total
Known diabetic	10	07	17
Euglycemic	43	07	50

$$\chi^2 = 5.66 (p < 0.05)$$

As compared to euglycemics, the mortality was higher in known diabetics and was statistically significant ( $p < 0.05$ ).

**Table No.11 Freshly detected diabetics Vs Euglycemic**

Glycemic status	Expired	Survived	Total
Freshly detected diabetic	03	04	07
Euglycemic	07	43	50

$$\chi^2 = 3.53 (p > 0.05)$$

As compared to euglycemics, though the mortality was higher in freshly detected diabetic, it was statistically insignificant ( $p > 0.05$ ).

**Table No.12 Stress Hyperglycemia Vs Euglycemics**

Glycemic status	Expired	Survived	Total
Stress hyperglycemic	06	0	06
Euglycemic	07	43	50

$$\chi^2 = 22.22 (p < 0.001)$$

As compared to euglycemics, the mortality was higher in stress hyperglycemics and was statistically highly significant ( $p < 0.001$ ).

## DISCUSSION

Stroke is common clinical problem. Current treatment for patient with established stroke is relatively ineffective. Effective risk factor interventions for diabetes, hypertension and others offer a real hope. It is important to determine whether a high serum glucose

concentration immediately after an acute stroke directly caused increased morbidity and mortality. In the present study, we included 80 acute first-time stroke patients and determined their glycemic status and prognosis.

**Table No. 13 Type of Stroke**

Type of stroke	Present study	Latheef AK et al <sup>52</sup>	Woo J et al <sup>53</sup>
Infarct	64.00%	70.50%	68.60%
Hemorrhage	36.00%	29.50%	31.40%

In this study, 64% of the patients had ischemic stroke, which was comparable with that found in the study of Latheef AK et al and Woo J et al (70.5% and 68.6% respectively). 36% had primary intracerebral hemorrhage in the present study

and 29.5% and 31.4% in the Latheef AK et al and Woo J et al study group. In this study, known diabetics (70.6%) and freshly detected diabetics (85.7%) had higher prevalence of ischemic stroke compared to euglycemics (66%).

**Table No. 14 Glycemic Status**

Glycemic status	Present study	Latheef AK et al <sup>52</sup>	Woo J et al <sup>53</sup>
Diabetics	30.00%	21.30%	24.25%
Known diabetics	21.25%	9.83%	6.25%
Freshly detected diabetics	8.75%	11.47%	18.00%
Stress hyperglycemic	7.50%	3.30%	9.60%
Euglycemics	62.5%	75.4%	66.15%



The prevalence of diabetes mellitus in stroke patients in this study was 30% which was moderately higher than that in Latheef AK et al (21.3%) and Woo J et al (24.25%). Prevalence of stroke in known diabetics was 21.25% in the present study, which was considerably higher than the other studies. Latheef AK et al (9.83%)

and Woo J et al (6.25%). Stress hyperglycemia was found in 7.5% in the present study, 3.3% in study by Latheef et al and 9.6% by Woo J et al study. Prevalence of stroke in euglycemics in the present study was comparable with Woo J et al study.

**Table No. 15 Prognosis**

Glycemic status	Poor outcome	
	Present study	Woo J et al <sup>53</sup>
Diabetics	87.50%	78.7%
Euglycemics	36.00%	63.4%

The diabetics with stroke had poor outcome (patient either expired or had no recovery) and was comparable with Woo J et al but in

euglycemics with poor outcome in Woo J et al study was higher than in the present study.

**Table No. 16 Glycemic status and its outcome.**

Glycemic status	Poor Outcome	
	Present study	Latheef AK et al <sup>52</sup>
Known diabetic	82.4%	66.7%
Freshly detected diabetic	100%	100%
Euglycemics	36%	50%

Both known diabetics and freshly detected diabetics with stroke are associated with higher percentage of poor outcome than euglycemic patients, consistent with study by Latheef AK et

al. The mortality rates in stroke patients with different glycemic status is statistically significant ( $p < 0.001$ ).

**Table No. 17 Mortality in stroke patients.**

	Present study	Latheef AK et al <sup>52</sup>	Woo J et al <sup>53</sup>	Santokh Singh et al <sup>54</sup>
Mortality in stroke patients with stress hyperglycemia	100%	100%	74%	67%

All patients with stress hyperglycemia had hemorrhagic stroke with 100% mortality, which was consistent with Latheef AK et al study.

**Table No.18 Glycemic status and mortality.**

Glycemic status	Mortality	
	Present study	Woo J et al <sup>53</sup>
Diabetics	41.67%	23.00%
Euglycemics	14.00%	24.00%



There was significant difference in mortality between diabetics and euglycemics in our study but Woo J et al study showed no much difference.

**Table No.19 Glycemic status and mortality in diabetes.**

Glycemic status	Mortality		
	Present study	Latheef AK et al <sup>52</sup>	Santokh Singh <sup>54</sup> et al
Known diabetics	41.00%	57.10%	16.00%
Freshly detected diabetics	43.00%	66.70%	40.00%
Euglycemics	14.00%	34.8%	10.00%

In the present study, both known diabetics and freshly detected diabetics with stroke are associated with higher mortality rate than euglycemics consistent with the study of Latheef AK et al study. In Santokh Singh et al study, there was significant difference only in freshly detected diabetics and euglycemics. In the

present study, as compared to euglycemics, though the mortality was higher in freshly detected diabetics, it was not statistically significant ( $p>0.05$ ). The mortality was significantly higher in known diabetic ( $p<0.05$ ) and stress hyperglycemics ( $p<0.001$ ), which was statistically significant.

**Table No. 20 Glycemic status and recovery**

Glycemic status	Complete recovery	
	Present study	Woo J et al <sup>53</sup>
Diabetics	0.00%	21.00%
Euglycemics	14.00%	31.00%

All patients with complete recovery were euglycemics (14%) and had ischemic stroke and no patient with complete recovery were in diabetic group but Woo J et al study showed complete recovery in 21% of diabetics and 31% of euglycemics. As in other studies, we found that higher plasma glucose concentration on admission were associated with a poor outcome. Therefore, the association between glucose concentration and outcome is less likely to be solely a stress response related to stroke severity but could be a result of harmful effects of glucose on damaged neurons. Thus, it is important to know the glycemic status of the patient after acute stroke, so that this factor may be therapeutically modified.

## CONCLUSION

The prevalence of stroke is maximum in age group of 60-69 years. The prevalence of diabetes mellitus in stroke patients is 30% of this 9% are freshly detected diabetics. Known diabetic and freshly detected diabetic patients are at higher risk of ischemic stroke. Stress hyperglycemia is associated with worst prognosis (100% mortality) and all had hemorrhagic stroke. Both known diabetic and freshly detected diabetics are associated with higher mortality and morbidity. This concludes diabetes is an important risk factor for stroke especially thrombotic and associated with high morbidity and mortality.

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