THE RELATIONSHIP BETWEEN ADMISSION BLOOD GLUCOSE LEVELS AND HOSPITAL MORTALITY

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ABSTRACT: AIMS/HYPOTHESIS: The purpose of this study was to examine the relationship among the blood glucose levels and mortality rates between the patients admitted to Intensive care unit.
METHODS: In a Retrospective Observational study, Blood glucose levels were measured on patients admitted to the Intensive care unit. These measurements were matched against demographic data and hospital mortality rates. **RESULTS:** Overall in-hospital mortality was 33%. Blood glucose levels during admission were an independent predictor of mortality. There was a significant interaction among baseline blood glucose status and mortality ($p<0.001$). Higher Blood glucose levels were associated with greater mortality evens between non-diabetes patients also. Between non-diabetes the lowest mortality rate (3.0%) was observed in a group of people with BGL between 100-140mg/dl. Compared with this group patients with a BGL of >140mg/dl had increased mortality rate ($p<0.001$, after adjustment for age and sex). The risk increased farther at higher glucose levels.
KEYWORDS: Blood glucose levels (BGL), Hyperglycemia, Impaired glucose tolerance, Mortality, Myocardial infraction.

INTRODUCTION: Hyperglycemia in critical illness is associated with increased mortality. This has been demonstrated in a number of clinical situations most notably myocardial infarction [1] stroke [2] and intensive care. [3] There are data available from a general hospital indicating that patients with newly diagnosed hyperglycemia have an increased risk of mortality. [4] It is however, unclear at what threshold of blood glucose leads to increase risk of mortality in hospitalized patients. Most studies have analyzed hyperglycemia as a dichotomized variable. [1, 2]But the cut-off levels used do not necessarily best reflect a threshold for increased in-hospital mortality rates. There is also paucity of data regarding the nature of relationship between the blood glucose levels (BGLs) and hospital mortality. A dose response relationship between BGLs and mortality has been demonstrated in myocardial infarction. [5] There are no such known data for hospitalized patients in general. To answer these questions we analyzed the relationship between BGL on hospital admission and inpatient mortality rates.

METHODS: This was a Retrospective observational study, all patients irrespective of their diagnosis and diabetes status, who were admitted to the Medical Intensive care unit were included in the study. Patient's age, sex, random blood sugar at admission, diagnosis and disease outcome were thoroughly studied and analysed. Details regarding diabetes status and other co-morbid conditions were enquired.

RESULTS: A total of 156 patients were included, out of which 78 were males and 56 were females. Mean random blood glucose level in these patients was 146mg/dl, with a standard deviation of 20.

There was an overall mortality of 53 patients (i.e., 33%). Among these, 32 patients (i.e. 66%) had random blood glucose level >140mg/dl. Among the 32, 11 patients had pre-existing co-morbidity in the form of diabetes. A statistically significant correlation was found between blood glucose level more than 140 mg/dl at admission and the mortality rate ($p<0.001$).

DISCUSSION: In this retrospective study, we found that even between the people without known diabetes, there is a strong association among blood glucose during admission and in-patient mortality, within the entirety of a heterogeneous population admitted. On analysis of BGL as a categorical variable, increased risk occurred above a BGL of 140mg/dl. Stress hyperglycemia in patients who are not known to have diabetes has been associated with greater mortality risk as compared to the patients with diabetes as such. [1, 2]Our data concur that the relationship among blood glucose levels and mortality rate is considerably stronger even in individuals without diabetes. For a given level of hyperglycemia, no diabetes patients probably have greater severity of illness, which contributed to increased mortality. However, it is possible that hyperglycemia itself also predisposes to increased mortality. In order to support this, it has been found that hyperglycemia is associated with increased release of C-reactive protein and other inflammatory cytokines, increased coagulability, oxidative stress, impairment of leucocyte function and increased rates of infection.[6]From the Meta-analysis studies, hyperglycemia was defined as an blood glucose levels above the 6.1–8.0 mmol/ levels to have relative risk of mortality among hyperglycemic patients who did not have diabetes was 3.9times for myocardial infarction [1] and 3.07 times for stroke.[2] Many of these studies examined mortality rates with glucose as a dichotomized variable which is often based on arbitrary cut-off levels or concentrations relating to the diagnosis of diabetes / impaired glucose tolerance. These cut-off levels do not necessarily best reflect a glucose threshold above which patients are at increased risk. We suggest that blood glucose levels of 140mg/dl may be an appropriate threshold for defining a minimum glucose level above which increased risk occurs and intervention might be considered. The Only limitation of the current study is that some of the hyperglycemic individuals classified as non- diabetes, may well have had undiagnosed diabetes. Additionally, we did not have a record of glycemic control during the hospital stay. However, patients admitted with hyperglycemia have been shown to have higher blood glucose levels on subsequent days. [7]

The Diabetes Mellitus Insulin–Glucose Infusion in Acute Myocardial Infarction (DIGAMI) study has also demonstrated that peri-infarct administration of insulin to maintain the blood glucose levels below 10 mmol/l reduces mortality. [9]

In one of the study, insulin infusion therapy did not improve the survival rate between hyperglycemic patients with myocardial infarction. [10]However the mortality rate after 6 months was only 2% among patients who maintained a mean blood glucose levels ≤148 mg/dl in the first 24 h, when compared to 11% among patients with a mean BGL >148.0 mg/dl.

The above studies clearly indicate that tight glucose control is likely to be beneficial in critically ill patients. It is as yet unknown whether this would also be applicable for general hospital patients without diabetes. Nonetheless, given the strong relationship between blood glucose levels during admission and mortality, we suggest that control of hyperglycemia in hospitalised patients may be of therapeutic value. In order to strengthen this we need to have randomised clinical trials should be performed to establish its beneficial role.

CONCLUSION: In-patient hyperglycemia is a common finding and important marker of poor clinical outcome and increase mortality, particularly in patients without a history of diabetes mellitus. All hospitalized patients should be screened for hyperglycemia. Aggressive glycemic control may reduce mortality in this population.

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Table 1: Age distribution of patients studied

Age in years	MLC-LIVE	MLC-DEATH	NON-MLC ALIVE	NON-MLC DEATH
17-20	12(17.9%)	2(6.9%)	6(35.3%)	2(6.5%)
21-30	34(50.7%)	12(41.4%)	4(23.5%)	5(16.1%)
31-40	11(16.4%)	6(20.7%)	2(11.8%)	11(35.5%)
41-50	6(9%)	2(6.9%)	4(23.5%)	5(16.1%)
51-60	1(1.5%)	2(6.9%)	2(2%)	4(12.9%)
61-70	5(4.5%)	5(10.3%)	6(5.9%)	4(12.9%)
Total	69(100%)	31(100%)	25(100%)	31(100%)
Mean ± SD	30.61±12.02	38.17±17.87	32.00±13.46	41.77±13.82

P = 0.06**

Table 2: Gender distribution of patients studied

Gender	MLC-LIVE	MLC-DEATH	NON-MLC ALIVE	NON-MLC DEATH
Male	43(64.2%)	14(48.3%)	13(64.7%)	16(51.6%)
Female	26(35.8%)	17(51.7%)	12(35.3%)	15(48.4%)
Total	69	31	25	31

Table: 3 Co morbid condition

Co morbid condition	MLC-LIVE	MLC-DEATH	NON-MLC ALIVE	NON-MLC DEATH
Nil	59(88.1%)	11(37.9%)	17(99.7%)	18(58.1%)
DM	04(0.05%)	8(10.3%)	3(0.14%)	3(6.5%)
HTN	2(3.0%)	4(24.1%)	0(0%)	3(9.7%)
Asthma	1(1.5%)	1(3.4%)	0(0%)	0(0%)
Alcohol	1(1.5%)	2(6.9%)	5(0.2%)	2(6.5%)
Old	0(0%)	2(6.9%)	0(0%)	0(0%)
HIV	0(0%)	0(0%)	0(0%)	4(12.9%)
Smoker	0(0%)	1(3.4%)	0(0%)	2(6.5%)
Post-partum	0(0%)	2(6.9%)	0(0%)	0(0%)
Hanging & epileptic	2(3.0%)	0(0%)	0(0%)	0(0%)

Table 4: Random Blood Sugar (RBS) of patients studied

RBS	MLC-LIVE	MLC-DEATH	NON-MLC ALIVE	NON-MLC DEATH
<100	15(21.4%)	5(17.9%)	8(32.0%)	6(.19%)
100-140	54(78.6%)	8(17.9%)	9(36%)	2(0.06%)
>140	0(0%)	18(64.3%)	8(32.0%)	23(74.2%)
Total	69	31	25	31
Mean ± SD	104.85±20.45	129.00±85.50	126.62±45.94	121.61±55.68

P = <0.001

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