



SCREENING OF HYPERGLYCEMIC PATIENTS ADMITTED IN INTENSIVE CARE UNIT

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¹Santosh Kumar, ²Awadhesh K Arya, ³Ritwiz Bihari, ⁴Deepa Pokharia, ⁵Hemant Kumar, ⁶Kamlakar Tripathi. Department of Medicine, Institute of Medical Sciences, Banaras Hindu University Varanasi, India, 221005.

ABSTRACT

CORRESPONDENCE :

Dr.Kamlakar Tripathi
Department of Medicine,
Institute of Medical Sciences,
Banaras Hindu University
Varanasi, India,
221005
Email:
kamlakar_tripathi@yahoo.co.in
Phone: +91542-6703324

Background & objectives: It is a prospective, randomized, controlled study involving adults admitted to medical Intensive care unit (ICU) who were receiving mechanical ventilation.

Methods: On admission, patients were randomly assigned to receive intensive insulin therapy (maintenance of blood sugar at a level between 80 and 110 mg/dl) and were found to have hyperglycemic. We study the clinical profile of critically ill hyperglycemic patients and associated metabolic profiles of all such patients were analyzed in relation to final outcome.

Results: The benefit of intensive insulin care was from 8.0 percent with conventional treatment to 4.6 percent ($P < 0.04$, with adjustment for sequential analyses). Intensive insulin therapy to maintain blood glucose at or below 110mg per deciliter reduced the morbidity and motility among critically ill patients in the surgical intensive care unit. Hyperglycemia was present in 38% of patient admitted to the hospital, of whom 26% had a known history of diabetes, and 12% had no history of diabetes before admission.

Interpretation & conclusions: New hyperglycemic patients had a longer length of hospital stay, a higher admission rate to an intensive care unit, and were less likely to be discharged to home, frequently requiring transfer to an intermediate care unit.

Key word: Hyperglycemia, ICU, Glucose Transporter, Insulin, Hypoxia, Nutrition.

“Uncontrolled hyperglycemia is one of the most precarious metabolic disorder worldwide propelling patients more closely to death those admitted in Intensive care unit.”

INTRODUCTION

The 1952 Scandinavian epidemic of poliomyelitis necessitated the mechanical ventilation of a large number of patients with respiratory failure, an intervention that reduced the mortality from 80% to 40%, since then development of sophisticated mechanical devices to support all vital functions, a wide range of powerful drugs and high-tech monitoring system have revolutionized modern intensive care medicine. This evolution improved short term survival of previously lethal conditions. Many patients now days indeed survive the initial shock phase of such condition but subsequently enter a chronic phase of critical illness. Mortality among such patients requiring intensive care for more than a few days has remained around 20% worldwide, to a large extent irrespective of the initial disease or trauma for which they were admitted to the Intensive Care unit (ICU). Most death in the ICU occurring beyond the first few days of critical illness are attributable to non resolving failure of multiple organ systems, either due to or coinciding with sepsis. An Increased susceptibility to infectious complications and the functional and structural sequel of the systemic inflammatory response to infection and cellular injury play a role.¹ Several evidence supports the concept that described cellular energy metabolism contributes to organ failure.² This were originally ascribed exclusively to inadequate tissue perfusion and cellular hypoxia. Recent studies, however, also point to a disturbance in oxygen utilization rather than delivery, which has been termed cytopathic hypoxia.^{3,4}

As hyperglycemia is a major risk factor for mortality in all critically ill patients, the objective of the present study to study the clinical profile of critically ill hyperglycemic patients and to study the associated metabolic profile of all such patients and final outcome.

MATERIALS AND METHODS

Selection of patients:

The selection of patient was done from the admitted patients from Medical Intensive care Unit of S.S. Hospital, Banaras Hindu, University, Varanasi during the period July 2007 to June 2010. The following criteria were employed for the selection of cases.

Inclusion Criteria: The subject with following criteria were include in the study protocol

1. ICU stay more than 3 days.
2. Presence of central lines.
3. Blood glucose more than 200 mg% on two occasion 2hr apart.

During these period 182 patients (of mentioned department) stayed in ICU for more than 3 days. The case which did not fulfill the inclusion criteria was excluded.

For the present study a total number of 96 cases were taken. In addition to required treatment decided by ICU-Doctors (and specialists when needed), their blood sugar level were controlled by following protocol.

Blood glucose control in ICU:

Insulin concentration= 1 unit/ml

Blood glucose to be estimated 1 or 2 hourly.

Target RBS	Non diabetics	Diabetics
	90-110mg%	110-130mg%

Table 1: Glucose conc. with Insulin infusion rate

Glucose (mg %)	Insulin infusion rate U/hr
>250	5
201-250	4
171-200	3
141-170	2
121-140	1.5
101-120	1
81-100	0.8
61-80	0.5
<60	Consider for 25% Dextrose

For diabetics consider as 25% Dextrose if RBS <100mg%.

If glucose concentration does not fall by 100mg% in first 2 hours, insulin dose should be doubled.

Insulin was administered according to protocol by insulin infusion pump which was based on measurement of whole blood glucose (capillary) with use of a glucose analyzer.

All patients were divided in two group on basis of peak blood sugar >300mg% and <300mg% were conducted and following through clinical examination and investigations.

Information's were also collected

1. Ventilators support
2. Insulin and mode of administration
3. Feeding (daily calories intake)
4. RFT and LFT
5. Numbers and severity of hypoglycemic episodes
6. Number of days in ICU
7. Provision diagnosis/diagnoses
8. Telephonic follow up at 1 month
9. Outcome

RESULTS

It was an observational study data presented as mean, range and frequency. The qualitative and quantitative data were cross tabulated when necessary. All analysis was done with the help of SPSS for windows software using Pearson Chi-square and student t-test as were required. A total of 96 cases were studied during a period of July 2006 to June 2007; out of which 16 were diabetics. Cases were distributed according to sex and age among which 44(45.8%) Patients had blood sugar level >300mg% and formed first group while 52(54.2%) patients had blood sugar less than 300mg% (Table 2).

A total of 16 patients had history of diabetes in this study. 24 patients had positive family history of diabetes with blood sugar level > 300mg% where as 37.5% patients who diagnosed first time to be hyperglycemic in ICU, had blood sugar level more than 300mg% (Table 3). There were 24% patients with Positive Family history of 1st degree relative for diabetes. 70.83% of such patient had blood sugar > 300mg%; 37.5% patient did not have family history for diabetes also had the blood sugar level >300mg% (Table 4).

Distributions of ICU stay of patients are described in (Table 5). Mean duration of ICU stay of such patient was 7.9 days and maximum ICU stay was 53 days. Sub group analysis in between patient with ICU stay >14 days and Blood sugar > 300mg % showed that out of 10 patient 7 patients had blood sugar level. But this data was failed to show statistical significance are shown in Table 6. During ICU stay 65 patients included in this study were expired and 26 patients showed Improvement and were shifted to their respective wards. Five patients in the

Study were discharged on request (DOPR) or left against medical advice (LAMA). Among 65 patients who expired 46.15% patients has blood sugar >300mg% (Table 7).

Total 31 patients were followed after they were discharged from ICU .1 patient was lost in follow up and 7 patients expired. Out of 23 survived patients 20 patients expired. Out of 23 survived patients 20 patients remained non diabetic (Table 8).

DISCUSSION

The present study was conducted to evaluate the outcome of those patients who were found to have hyperglycemic with spot blood sugar >200mg%. Out of all admissions through General Medicine, Gastroenterology, Endocrinology, Neurology, Nephrology and Emergency OPD, 182 Patients stayed in ICU for more than 3 days out of which 96 patients were analyzed for clinical presentations, complication and its final outcome in follow up in relation to hyperglycemia.

In the present study male female ratio was 2:1. We observed male predominance (Table1). Since our hospital is a tertiary care hospital where majority of patients are male, this observation is reflection of giving more importance to male members in comparisons to female. Mean age in this study was 44.2±18.8 years with minimum age 15 years and maximum age 84 years. In the study by Greet Van Den Berghe et al; in medical ICU, mean age was about 64±16 years.⁵ This may be due to lesser admission of elderly in our ICU.

In developing country like India, where poor hygiene, humid environment and low awareness are prevalent, infectious diseases are common. In Greet Van den Berghe study in medical ICU 46.8% were admitted due to respiratory infection and could be the reason for higher admission with infective disorders , septicemia and 20.86% patients were related to G.I. System. In present study 25% patients had positive family history of 1st degree relative for diabetes. Seventy-one % of such patients had suffered from blood sugar >300mg% and 37.5% patients who did not have family history for diabetes also come under the same history of diabetes and had higher probability hyperglycemia. Mean duration of ICU stay was 7.9 days. Maximum ICU stay

Table 2: Age Distribution with hyperglycemia

Age	Patient with blood sugar>300mg%		Patient with blood sugar>300mg%		Total No. of patients	
	No.	%	No.	%	No.	%
15-25	7	15.91	13	25.00	20	20.83
26-35	11	25.00	15	28.85	26	27.08
36-45	6	13.64	13	25.0	19	19.79
46-55	3	6.82	1	1.92	4	4.17
56-65	9	20.45	6	11.54	15	15.63
66-75	3	6.82	4	7.69	7	7.29
76-85	5	11.36	0	0	5	5.21
Total	44	100	52	100	96	100

Chi-square X² = 4.73 d f = 1 p value = 0.03

Table 3: Distribution of patients according to history of diabetes:

	Known Dia		Non Diabetic		Total	
	No.	%	No.	%	No.	%
Patient with blood sugar>300mg%	14	87.5	30	37.5	44	37.5
Patient with blood sugar<300mg%	2	12.5	50	62.5	52	62.5
Total	16	100	80	100	96	100

Chi-square X²=13.427(b) d f =1 p value<0.000

Table 4: Distribution of Patients according to family history of diabetes

	Positive family History of diabetic		Negative Family History of Diabetic		Total	
	n	%	n	%	n	%
Patients with blood sugar>300mg%	17	70.8	27	37.5	44	45.8
Patients with blood sugar < 300mg%	7	29.2	45	62.5	52	54.2
Total	24	100	72	100	96	100

Chi-square X²=8.056(b) d f = 1 p value=0.005
 was 53 days (Table 5). 10.41% Patient stayed in ICU for more than 14 days. Out of this 70% patients had blood sugar >300mg%. 89.58% patient had ICU stay for <14 days. In this group 43% patient had blood sugar >300mg% (Table 6). In the study of Greet van Den Berghe et al; in medical ICU control of hyperglycemia to normal level was related to reduction in ICU stay.⁵ This observation is similar to the present study (70% patient of ICU stay >14 days had severe degree of hyperglycemia). In patient who suffered from hypoglycemia, 61.29% had blood sugar level >300mg% and 38.70% had blood sugar level <300mg%. This difference is difficult to explain, however it appears that intensive insulin therapy in hyperglycemic patient may be a contributory factor patients.

In other studies it was found that incidence of hypoglycemia was high in ICU.⁶ In the present study hypoglycemia was only significant associated with duration of stay as all 10 patients who stayed in ICU for more than 14 day, suffered from at least 1 episode of hypoglycemia. In the study by Greet Van den Berghe et al in medical ICU, independent risk factor for hypoglycemia, aside from intensive insulin therapy were renal failure requiring dialysis, liver failure and ICU stay for 3 or more days.⁵ Another study by Marjolien et al. have shown that high glucose value at the time of admission is related with over all high mortality in the non diabetic cohort but not in diabetic cohort.⁷

One of the causes of higher mortality amongst patient of hyperglycemia is association of pneumonia

Table 5: Duration of ICU days

Duration of stay	Patient with blood sugar >300mg%		Patient with blood sugar <300mg%		Total Patient	
	n	%	n	%	n	%
3	8	18.18	8	15.38	16	16.67
4	4	9.09	11	21.15	15	15.63
5	7	15.91	11	21.15	18	18.75
6	5	11.36	6	11.54	11	11.46
7	4	9.09	6	11.54	10	10.42
8	5	11.36	2	3.85	7	7.29
9	1	2.27	3	5.77	4	4.17
12	0	0	2	3.85	2	2.08
13	3	6.28	0	0	3	3.13
>14	7	15.91	3	5.77	10	10.42
Total	44	100	52	100	96	100

Chi-square $X^2=1.76$ d f =1 p value=0.183

Table 6: Relation of hyperglycemia with ICU stay>14 days

	ICU stay>14 days		ICU stay<14days		Total	
	n	%	n	%	n	%
Patients with blood sugar >300mg%	7	70.00	37	43.0	44	45.8
Patients with blood sugar <300mg%	3	30.0	49	57.0	52	54.2
Total	10	100	86	100	96	100

Chi-square $X^2=2.626(b)$ d f =1 p value=0.105

Table 7: Out come of Patients from ICU

Outcome	Expired		Shifted		DOPR/LAMA		Total	
	n	%	n	%	n	%	n	%
Patients with blood sugar>300mg%	30	46.15	09	34.62	5	100	44	45.83
Patients with blood sugar<300mg%	35	53.85	17	65.38	0	0	52	54.17
Total	65	100	26	100	5	100	96	100

Chi-square $X^2=0.085(a)$ d f=3 p value=0.770

in elderly patients with fasting hyperglycemic.⁸ Another study have shown that hyperglycemia, hypoglycemia and increased glycemic variability in each group is independently associated with mortality in critically ill patients.⁹ Even among pediatrics patient hyperglycemia was prevalent after major abdominal surgery in

Intensive Care Unit (ICU) and glycemic control improve the clinical outcome.¹⁰ In a study amongst 398 patients during follow up in Medical ICU those who did not have previous study of diabetes, 3.5% were found to have hyperglycemia.¹¹

In this study 193 patients had hyperglycemia at the

Table 8: Follow up at 1 month

Follow up at 1 month	Non diabetic		Diabetic		Expired		Lost		total	
	n	%	n	%	n	%	n	%	n	%
Patient with blood sugar >300mg%	3	15	3	100	7	100	1	100	14	45.16
Patient with blood sugar <300mg%	17	85	0	0	0	0	0	0	17	54.84
Total	20	100	3	100	7	100	1	100	31	100

Chi-square $\chi^2=0.55(a)$ d f =3 p value=0.045

the time of admission and 17.1% developed Type-II diabetes mellitus during subsequent follow up to 6 years. In this study we did not follow these patients for longer period. However in subsequent weeks of follow up for 4 weeks, 46.15% patients expired. These observations provide a strong background for a long term follow up to those patients who become hyperglycemic and may convert into stabilized T2DM.

CONCLUSION

Hyperglycemia occurs frequently in critically ill patients. Mechanism includes insulin resistance, absolute or relative insulin deficiency, impaired glucose metabolism and effects of medications such as corticosteroids and heavily caloric enteral and parenteral nutritional supplements. As hyperglycemia is associated with increased mortality and morbidity in critically ill patients, the present study entitled "Screening of hyperglycemic Patients Admitted in ICU" has been undertaken with objectives to study clinical presentation complications and its final outcome of critically ill patients in relation to hyperglycemia.

Based on the finding of the study present in the 'observation' and the 'discussion' the following conclusions have been made.

1. Hyperglycemia in ICU is a common finding even in non Diabetic patients.
2. Most of the patients admitted in present study were in between 15 to 46 years.
3. Severity of hyperglycemia was more in elderly population.
4. History of Diabetes has directed correlation with

hyperglycemia.

5. In the same manner family history for Diabetes is also associated with hyperglycemia.

6. Hypoglycemic events were frequent in ICU in spite of monitoring.

7. Hypoglycemic events were directly related to severity of hypoglycemic and longer duration of stay in ICU.

8. Patients who had severe hyperglycemia had poorer outcome i.e. severity of hyperglycemia is related to prognosis.

9. In hospital mortality of patients in present study was 67.70%.

Based on conclusion reached, the following recommendations are made for management of ICU patients. Intensive Blood sugar monitoring is required even in patients who are not known diabetics. Old age, history of diabetes family history of diabetes and prolonged ICU stay are risk factor for hyperglycemia and when present requires more care. Hypoglycemic events are also very common in hyperglycemic patients in ICU and hypoglycemia can go to dangerous level for health. Hyperglycemia can also be used as prognostic marker.

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Authors Contributions:

SK: Concept and Design of the study, analysis and interpretation, manuscript preparation, critical revision of the manuscript, data collection, statistical analysis, and literature search.

AKA: Concept and Design of the study, analysis and interpretation, manuscript preparation, critical revision of the manuscript, data collection, statistical analysis, and literature search.

RB: Concept and Design of the study, analysis and interpretation, manuscript preparation, critical revision of the manuscript, data collection, statistical analysis, and literature search.

DP: Manuscript preparation and critical revision of the manuscript.

HK: Revision of the manuscript and Literature search.

KT: Concept and Design of the study, analysis and interpretation, critical revision of the manuscript.

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