Epidemiology and clinical outcome of ICU-acquired Stress hyperglycemia in Critically ill Medical patients (Single center study)

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Abstract: Stress hyperglycemia is common in critically ill patients, even without a history of diabetes. It has been recently recognized to be associated with increased mortality and morbidity. Therefore this study was designed to assess the prevalence of stress hyperglycemia in Medical Intensive Care Subunits of Zagazig University Hospitals and to study why some individuals develop stress hyperglycemia and others will not in similar clinical and metabolic circumstances by estimation of relative risk of some risk factors (age, BMI, SBP, +ve family history of DM and APACHE II score of severity), and lastly to predict the clinical outcome of stress hyperglycaemic patients in medical ICU. **Patients and methods** This cross sectional observational prospective study included747 subjects admitted in medical ICU Subunits in period of six months, 224 of these patients were admitted to cardio-pulmonary subunit, 137 patients were admitted to stroke subunit, 258 patients were admitted to general subunit, and 128 patients were admitted to hepato gastroenterology subunit. the included subjects were subdivided to three groups according to FBG, RBG, and HbA1c, as follow: Group I (Normoglycemic group included 408 patients,Group II(Non diabetic stress hyperglycaemic group included 136 patients with no history of diabetes on admission. Group III (Diabetic group included 203 patients. All subjects of this study were subjected to full history, through physical examination and Routine investigations which include(Complete blood picture, Liver and Kidney function tests, Arterial blood gases,RBG. FBG, HbA1c and ICU severity was assessed by APACHE II score. **Results** We found that the patients with stress hyperglycemia were (18.21%) and the diabetic patients were (54.61%) while the normglycemic patients were (27.17%). And the highest frequency of patients developed stress hyperglycemia was observed in cardio-pulmonary subunit (25%), followed by stroke subunit (21.8%), and the lowest frequency was in both general and gastroenterology and hepatology subunits (13.5%, 11.71% respectively.) and the presence of +ve family history of diabetes, age > 50 years, BMI > 25kg /m^2,SBP >130mmHg, and APACHE II score > 16 increase the relative risk of occurrence of stress hyperglycemia by 3.37, 2.05, 2.42, 3.43, 2.5 fold respectively. The results revealed that the mean duration of ICU stay for patients with stress hyperglycemia was significantly increased (6.64 ± 4.80 days) compared to diabetics (6.34±6.34days) and normoglycemic patients (5.01±3.09days) and the patients with stress hyperglycemia had lower improvement rates at the time of discharge (49.26%) compared to diabetics (65.02%), and normglycemic patients(67.15%) and patients with stress hyperglycemia were more complicated at the time of discharge (11.76%) than diabetics (6.40%) and normoglycemic(5.88%). In addition, the mean mortality rate for the patients with stress hyperglycemia was (38.97%) compared to diabetics (28.57%) and normoglycemic (26.56%) subjects. **Conclusion** We can conclude that the stress hyperglycemia is significantly prevalent in medical ICU of Zagazig University Hospitals with highest figures among patients with cardiovascular and cerebrovascular emergencies. Also there are many risk factors that may increasing the risk of occurrence of stress hyperglycemia in stressful conditions more than others the most risky one was positive family history followed by increased systolic blood pressure,BMI,then age and finally stress hyperglycemia in ICU worsen the APACHEII score and increase the mortality and duration of hospital stay. Therefore strict control of stress hyperglycemia is recommended to decrease mortality and hospital stay in ICU.

[Osama A. Khalil, Monkez M. Yuossef, Magda M. Sherif, Alsayed Alnahall and Ghonium M.E. **Epidemiology and clinical outcome of ICU-acquired Stress hyperglycemia in Critically ill Medical patients (Single center study.** *J Am Sci* 2013;9(6):406-413]. (ISSN: 1545-1003). http://www.jofamericanscience.org. 49

Key words: American Diabetic Association (ADA), Random blood glucose (RBG), Fasting blood glucose(FBG), APACHE II score: Acute Physiology And Chronic Health Evaluation, Intensive care unit(ICU), Free fatty acids(FFAs).

1. Introduction

Hyperglycemia is a common occurrence in the critical ill even without history of diabetes and has long been recognized as a costly health care problem in hospitalized patients **(1).**The American Diabetes Association (ADA) (**2**) consensus on inpatient hyperglycemia defined stress hyperglycemia as any blood glucose concentration > 7.8 mmol /l (140 mg/dl) without evidence of previous diabetes. Although stress hyperglycemia typically resolves as the acute illness or

surgical stress abates, it is important to identify and track patients as 60% of patients admitted with new hyperglycemia had confirmed diabetes at 1 year (**3**). **Wexler *et al.* (4)** showed that nearly one in five adult patients with "stress" hyperglycemia have probable unrecognized diabetes as identified by an admission HbA1c > 6.1% which speaks to the fact that nearly one-third of patients with diabetes are unaware of their diagnosis (**5**).Cross-sectional studies of patients with stress hyperglycemia revealed that 30%–60% of patient with stress hyperglycemia have impaired carbohydrate intolerance or diabetes during follow-up **(3**). Until recently, clinical guidelines recommended that all patients with stress hyperglycemia should be tested with use of HbA1c in hospitalized patients with hyperglycemia (**6**). Measurement of an HbA1c during periods of hospitalization provides the opportunity to differentiate patients with stress hyperglycemia from those with diabetes who were previously undiagnosed, as well as to identify patients with known diabetes who would benefit from intensification of their glycemic management regimen **(5).** Hyperglycemia is a frequent manifestation of critical and surgical illness, resulting from the acute metabolic and hormonal changes associated with the response to injury and stress **(8**). Acute illness, surgery, and trauma raise levels of counter regulatory hormones such as glucagon, epinephrine, cortisol, and growth hormone. The counter regulatory response results in a number of alterations in carbohydrate metabolism, including insulin resistance, increased hepatic glucose production, impaired peripheral glucose utilization, and relative insulin deficiency. Epinephrine stimulates glucagon secretion and inhibits insulin release by pancreatic B cells(**9**). High cortisol levels increase hepatic glucose production, and stimulate protein catabolism and increased circulating amino acids concentration, providing precursors for gluconeogenesis **(10).** In addition, acute stress increases pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNF-a), interleukin (IL)-6, and IL-1**,** (**11**) which increase insulin resistance by interfering with insulin signaling. Downstream effect process decreases insulin stimulation of glucose uptake and causes hyperglycemia (**12**). Thus stress adversely affects multiple biological processes resulting in diminished insulin action and if the pancreas is unable to compensate by increasing insulin production, the end result is the appearance of hyperglycemia. Furthermore, in the presence of hyperglycemia, the pancreatic b-cells develop desensitization that results in further blunting of insulin secretion and increasing serum glucose levels(**13**). Counter regulatory hormones in the setting of stress lead to enhanced lipolysis and increasing free fatty acids (FFAs) concentration (**14**). In patients with ischemic cardiovascular events, high FFA levels can aggravate ischemia/reperfusion damage by limiting the ability of cardiac muscle to uptake glucose for anaerobic metabolism **(15**). FFAs, normally the substrate of choice for healthy myocardium, are toxic to an ischemic myocardium (**16)** leading to cardiac arrhythmias, sympathetic over activity, increased blood pressure, oxidative stress and endothelial dysfunction (**17**). Increased FFA levels also produce dose dependent insulin resistance in peripheral tissues and increase hepatic glucose output in both diabetic and non-diabetic individuals (**18**). Hyperglycemia state caused by these mechanisms often times is worsened by exogenous use of glucose in form of nutritional supports or intravenous dextrose in critical care settings (**19**).The development of hyperglycemia leads to generation of reaction oxygen species (ROS), Lipid peroxidation, elevated cardiovascular inflammatory markers. Acute hyperglycemia may induce cardiac myocyte death through apoptosis or by exaggerating ischemia-reperfusion cellular injury (**20**). It also has deleterious effect on endothelial function by suppressing formation of nitric oxide (NO) and impairing endothelium-dependent flow mediated dilation (**21).** In addition, hyperglycemia -induced abnormalities in hemostasis including increased platelet activation, adhesion and aggregation, reduced plasma fibrinolytic activity and increased plasminogen activator inhibitor-1 (PAI-1) activity (**22**). *In vitro* and *in vivo* studies have also shown that hyperglycemia also impairs immune system function by reducing phagocytic activity of macrophages, impairing chemotaxis of polymorphonuclear neutrophils (PMNs), increasing expression of adhesion molecules and free radical production in immune cells which will ultimately increase the risk of infection and multiple in hospital complications **(23**). However the intensive control of hyperglycemia in patients of medical ICU, with acute coronary syndrome and stroke improve their clinical outcomes **(24**). Therefore this study was designed to assess the prevalence of stress hyperglycemia in Medical Intensive Care Subunits of Zagazig University Hospitals and to study why some individuals develop stress hyperglycemia and others will not in similar clinical and metabolic circumstances by estimation of relative risk of some risk factors (age, BMI, SBP, positive family history, and APACHE II score of severity),and lastly to predict the clinical outcome of stress hyperglycaemic patients in medical ICU.

2.Subjects and methods

This is observational prospective cross sectional study had been carried out in medical ICU of internal medicine of Zagazig University Hospitals which includes 4 subunits; cardio-pulmonary,stroke, general, and hepato-gastroenterology subunit, in the

period of six months; they were followed and assessed for inclusion in the study. Out of 800 patients who were admitted in the ICU subunits in the period from January to June 2012 only 747 patients were included in the study because of full data availability. The remaining number were excluded due to missed data, 449 of them were male and 298 of them were female and their age ranging from 18 up to 75years. 224 of these patients were admitted to cardio-pulmonary subunit, 137 patients were admitted to stroke subunit, 258 patients were admitted to general subunit, and 128 patients were admitted to gastroenterology and hepatology subunit. The included subjects were subdivided to three groups according to FBG, RBG,and HbA1c **(2).**

Group I:(Normoglycemic group) included 408 patients without current or previous history of hyperglycemia FBG <100 mg/dl, RBG<140 and HbA1c <5.6%).

Group II: (Non diabetic stress hyperglycaemic group) included 136 patients non diabetic with stress hyperglycemia (FBG >100 mg/dl or RBG >140 mg/dl and HbA1c≤6.5%).

Group III: (Diabetic) included 203 diabetic patients their FBG >126mg/dl, RBG>200 and HbA1c>6.5%).

All subjects of this study were subjected to full history, through physical examination and Routine investigations which include (Complete blood picture, Liver and Kidney function tests, admission blood glucose (RBG). fasting blood glucose (FBG),HbA1c **(7**), Arterial blood gases,serum electrolytes,urine analysis, Lipid profile and ICU severity was assessed by APACHE II score (**25**). In addition to other investigations that may be needed during ICU stay eg. (ECG, CT chest ect.,). Patients were followed up during stay in ICU with good control of blood glucose level as possible by insulin, and patients outcome (morbidity or mortality) as well as duration of stay in ICU were observed and recorded.

Exclusion criteria

Any patient with missed data.

Ethical clearance

Informed consent was taken from the patient's relatives to participate in this study.

Statistical analysis :

The collected data were analyzed by using computerized software statistical packages (EPI –info Version 6.04 &SPSS version 19). $p<0.05$ was considered to be statistical significant,Chi-square was used to compare proportions. analysis of variance (ANOVA or F test and LSD) were used to compare means among more than two groups. In addition to the termination of relative risk of some factors that predispose to stress hyperglycemia (**26)**

3.Results

Table (1): Shows the frequency and percentage distribution of studied subjects, stress hyperglycemia (18.21%), diabetic group (27.1%)and normoglycemic (54.6%).

Table (2): Shows frequency and percentage disturbution of stress hyperglycemia group among different subunits, the highest frequency of patients developed stress hyperglycemia was observed in cardio-pulmonary subunit (25%), followed by stroke unit (21.8%), and the lowest frequency was in both general and gastroenterology and hepatology unit (13.5%, 11.71% respectively.)

Table(3): Shows highly statistically significant increase in mean values +SD of age ($p<0.008$) of the patients with stress hyperglycemia and they were older than patients in the other group and also highly statistically significant increase ($p<0.001$) in mean values ±SD of metabolic parameters ABG, FBG, HA1c, in diabetic group compared to stress hyperglycemic and normoglycemic with statistically significant increase in stress hyperglycaemic compared to normoglycemic group, and also there was statistically significant increase in mean values ±SD of Platelet,HB, and albumin in stress hyperglycaemic group as compared to normoglycemic group while there was statistically significant difference regarding other parameters.

Table(4) shows increase relative risk of occurrence of stress hyperglycemia in patients with +ve family history of diabetes, age > 50 years, BMI > 25kg /m2,SBP>130mmHg, and APACHE II score > 16 increase the relative risk of occurrence of stress hyperglycemia than those with negative family history of diabetes, age < 50, BMI < 25, SBP <130 and APACHE II score<16 by 3.37, 2.05, 2.42, 3.43, 2.5 fold respectively.

Table (5): Determining the predictor of occurrence of stress hyperglycemia by back word step wise regression analysis of many risk factors mentioned in previous table, so the most risky factor associated with highly significance is the positive family history followed by increasing systolic blood pressure then increasing APACHE II score level.

Tables (6,7): Show absence of correlation between admission and fasting blood suger level and each of APACHE II score, predicated mortality or duration of ICU stay among three study group.

Table (8): Shows statistically significant increase in mean values ±SD ($p<0.05$) of APACHE II score, predicated mortality, or duration of ICU stay in stress hyperglycaemic group compared to diabetic group and normoglycemic group,with statistically significant increase diabetic group compared to normoglycemic group. while there was statistically significant decrease in mean values ±SD of outcome parameters (either dead or improves or complicated) in stress

hyperglycaemic group compared to diabetic group and normoglycemic group,with statistically significant decrease in diabetic group compared to normoglycemic group.

Table (1): Frequency and percentage distribution of studied subjects.

Groups	Frequency	Percentage (%)
I-Stress hyperglycemia	136	18.2
II-Diabetic	203	27.1
III-Normoglycemia	408	54.6
Total	747	100

Table(2): Prevalence of stress hyperglycemia in different medical ICU Subunits.

	Total number of patients	Number of patients with stress hyperglycemia
Cardio-pulmonary subunit	224(29.98%)	56(25%)
Stroke subunit	137(18.34%)	30(21.8%)
General subunit	258(34.53%)	35(13.5%)
GIT and hepatology subunits	128(17.13%)	15(11.71%)
Total	747(100%)	136(18.2%)

Table (3) Comparison of the mean value ±SD of the demographic,clinical and biochemical characteristics of different studied groups

Variable		Normoglycemic N= 408 Mean±SD	Stress hyperglycemia N=136 Mean±SD	Diabetic N=203 Mean±SD	F	*p*
Sex	Male	247 (60.5%)	82(60.3%)	120 (59.1%)		0.94
	Female	161 (39.5%)	54(39.7%)	83 (40.8%)		
Age (years)		56.56±14.23	61.01±15.69	56.57±15.90	4.906	**0.008**
BMI(kg/m2)		25.01±2.71	28.1±3.32	26.9±2.96	3.98	0.5
SBP(mmHg)		128.75±32.29	132.28±30.57	128.45±31.30	0.735	.480
DBP(mmHg)		82.20±19.09	83.90±19.10	82.27±19.44	0.423	.655
Admission RBS (mg/dl)		146.31±31.22	238.35±61.02 **a**	302.40±126.10 **ab**	313.37	**<0.001**
FBG (mg/dl)		94.20±14.34	158.48±38.34 **a**	228.26±125.80 **ab**	361.86	**<0.001**
HA1c (%)		3.9±o.59	5.1±1.2 **a**	7.1±1.5 **ab**	87.1	**<0.001**
Hb (g/L)		10.68±2.53	12.01±9.37 **a**	11.05±2.38	4.282	**0.01**
Platelet x103/cm		188.27±101.19	207.04±125.85 **a**	216.20±98.03	5.207	**0.01**
S,creatinine (mg/dl)		1.78±4.52	2.09±12.32	2.32±3.02	0.643	0.52
Albumin(g/L)		3.39±0.74	3.60±0.82 **a**	3.56±0.71	5.307	**0.01**

a:significant as compared to normoglycaemic group
b:significant to stress hyperglycemic group

Table(4) : Relative risk of increasing Age, BMI, +ve family history, SBP, APACHEII score on stress hyperglycemia group compared to normo-glycemic group.

	Stress hyperglycemia N=136	Normoglycemia N=408	total	Relative risk (RR)
Age >50	74	173	247	
Age <50	62	235	297	2.05fold
BMI>25mg/m2	92	160	252	
BMI<25mg/m2	44	248	292	2.42fold
+vefamily history ofdiabetes	85	95	180	3.37.fold
-vefamily historyof diabetes	51	313	364	
SBP>130 mmHg	71	102	173	3.43fold
SBP<130 mmHg	65	306	371	
APACHE IIscore>16	98	177	275	2.5fold
APACHEI Iscore<16	38	231	269	

Table(5) :Back word step wise regression analysis for the significant risk factors of stress hyperglycemia

Factor	Beta coefficient	Zvalue	RR
+ve family history of diabetes	1.3+1.87	6.5	3.33*
SBP>130 mmHg	1.2+1.68	6.3	3.32*
APACHE IIscore>16	.05+0.16	3.4	2.1*

*significant value

Table (6):Correlation coefficient between admission RBG versus each of APACHEII score,predicated mortality and duration of ICU stay among the three studied groups.

	Normoglycemic group		Stress hyperglycemia		Diabetic group	
variable	r value	*P* valuep	r value	*P* value	r value	*P* value
APACHE II	0.019	0.7	0.127	0.141	0.072	0.335
Predicated mortality(%)	0.007	0.887	0.134	0.127	0.042	0.0581
Duration of ICU stay(day)	0.016	0.744	0.04	0.637	0.035	0.642

Table(7): Correlation coefficient between fasting blood glucose(FBG) versus each of APACHEII score, predicated mortality and duration of ICU stay among the three studied groups.

	Normoglycemic group		Stress hyperglycemia		Diabetic group	
variable	r value	*P* valuep	r value	*P* value	r value	*P* value
APACHEII	0.051	0.309	0.052	0.551	0.085	0.228
Predicated mortality (%)	0.048	0.336	0.061	0.479	0.074	0,297
Duration of ICUstay(day)	0.048	0.332	0.031	0.718	0.038	0.595

Table (8): Comparison of Mean ±SD OF APACHEII score and predicated mortality, Duration of ICU stay and outcome parameters among studied groups.

		Normoglycemic N=408 (X±SD	Stress hyperglycaemic N=136(X±SD)	Diabetic N=203 (X±SD)	F	*P*
APACHEII score		16.23±6.44	18.9±7.73 **ab**	16.98±7.10 **a**	8.7	0.021
Predicated mortality(%)		27.41±18.12	32.94±21.58 **ab**	29.54±19.3 **a**	9.8	0.013
Duration of ICU stay (day)		5.01±3.09	6.64±4.80 **ab**	6.34±3.80 **a**	6.3	0.05
outcome	dead	110(26.56%)	53(38.97%) **ab**	58(28.57) **a**	0.03	
	improved	274(67.15%)	67(49.26%) **ab**	122(63.02) **a**		
	complicated	24(5.88%)	16(11.76%) **ab**	23(8.40%) **a**		

a: as compared to normoglycemic group; **b**:as compared to diabetic group.

4.Discussion

Hyperglycemia associated with critical illness(also called stress hyperglycemia or stress diabetes) is a consequence of many factors, including increased cortisol, catecholamines, glucagon, growth hormone, gluconeogenesis, and glycogenolysis (**27**). Insulin resistance may also be a contributing factor, since it has been demonstrated in more than 80 percent of critically ill patients **(4).**

Hyperglycemia was previously considered an adaptive response essential for survival and was not routinely controlled in intensive care units (ICU) **(7)**.

However, more recent evidence indicating that uncontrolled hyperglycemia is associated with poor outcomes has prompted efforts to routinely correct and prevent hyperglycemia in critically ill patients.

Therefore this study was designed to assess the prevalence of stress hyperglycemia in Medical Intensive Care Subunits of Zagazig University Hospitals and to study why some individuals develop stress hyperglycemia and others will not in similar clinical and metabolic circumstances by estimation of relative risk of some risk factors.

1n our study out of 800 patients admitted to medical ICU subunits of Zagazig University Hospitals only 747 patients were included because of full data availability and the remaining number were excluded due to missed data,we found that the prevalence of stress hyperglycemia was (18.2%) and there was marked variations of stress hyperglycemia in different subunits of ICU. The highest frequency of patients developed stress hyperglycemia was observed in cardio-pulmonary subunit (25%), followed by stroke unit (21.8%), and the lowest frequency was in both general and gastroenterology and hepatology unit (13.5%, 11.71% respectively. These results were

compatible with results from **Waeshle *et al.* (29)** who reported that cardiac patients in ICU had a high susceptibility for hyperglycemia, also beta cell dysfunction was associated with cardiac failure in critical ill patient. Also study by **Smith *et al.* (30)** revealed that the incidence of stress hyperglycemia was higher in patients with central nervous system damage and sever acute pancreatitis than in other etiological groups. This frequency of stress hyperglycemia in cardiac and stroke patients was explained by high prevalence of metabolic syndrome among those patients **(31)**.

However it is not clear why some individuals will develop stress hyperglycemia and other will not in similar clinical and metabolic circumstances. It may be that the individuals who develop stress hyperglycemia have latent homeostatic glucose defect that is unmasked during exposure to medical stress. In fact, 25% of patients who had hospital related hyperglycemia developed diabetes mellitus at one year of follow up (**28)**.To know why some individuals develop stress hyperglycemia and others will not under exposure to the same stress full conditions we study the relative risk of some risk factors for the occurrence of stress hyperglycemia We found that positive family history of diabetes increase the relative risk of occurrence of stress hyperglycemia by 3.37 fold than those with negative family history of diabetes. This consistent with **Mc cowen (32**) who reported that off spring of diabetic patients are risky for development of hyperglycemia and later on diabetes. **Kahan (33)** reported that risk of stress hyperglycemia begin at age of 45 years, these results are compatiable with our study as increasing age > 50 years increase the relative risk of occurrence of stress hyperglycemia by 2.05 fold than those with age <50 years, and it is known that the increasing of age was associated with atherosclerosis, which leads to a loss of plasticity in physiological adaptive response mechanisms associated with metabolic responses to stress **(33).** In our study increased body mass index (BMI) >25 kg/m2 increase the relative risk of occurrence of stress hyperglycemia by 2.42 fold than those with BMI<25 mg/m2 because of increased BMI and FFA levels also produce dose dependent insulin resistance in peripheral tissues and increase hepatic glucose output in both diabetic and non-diabetic individuals (**18**) this was coincided with studies of **Chiu *et al.* (34)** who assessed the increase in hyperglycemia is further associated with increase BMI ≥ 25kg/m2.

Vasan *et al.* (35) assessed that prehypertension (systolic hypertension between 120-139mmHg or diastolic blood pressure between 80-90 and CVD risk have strong relationship with hyperglycemia, we found that the increasing SBP>130mmHg increase the relative risk of occurrence of stress hyperglycemia by 3.43 fold than those with SBP<130 mmHg,and this may be due to a high blood pressure is a classical feature of the metabolic syndrome, which is associated with glucose intolerance and insulin resistance **(31)**. As regard to the last possible risk factor in the current study we found that increasing in APACHE II above 16 will increase the relative risk of occurrence of stress hyperglycemia by 2.5f old compared to those APACHE II score <16. This mean that the more ill and morbid patients are more susceptible for development of stress hyperglycemia. In our study multivariate regression analysis of many risk factors (age, BMI, SBP, positive family history of diabetes, and APACHE II score of severity) was done to determine the predictor of occurrence stress hyperglycemia, we found that the most risky factor associated with highly significance is a positive family history of diabetes, followed by increasing systolic blood pressure then increasing APACHE II score.

Lastly our study assess the clinical outcome of stress hyperglycemia in ICU patients by assessment the severity with APACHE II score, mortality and hospital stay to studied groups. The APACHE II score showed a statistically significant increase in stress hyperglycaemic group compared to diabetic and normoglycemic groups, These results were different from those of **Cao *et al.* (36**) who reported that the effect of stress hyperglycemia had no significance on the outcome or mortality in ICU patients and this difference may be because of the morbid diseases and severity of illness in our subjects in ICU than those who were admitted in hospital word.

Mccown (32) reported that the relationship between hyperglycemia in critically ill patients that the majority of whom do not have underlying diabetes mellitus and the worse outcomes in most previous observational studies is probably not causal but a reflection of severity of illness. these results were consistent with our study which showed that there is a statistically significant increase of predicted mortality and duration of hospital stay in stress hyperglycaemic patient compared to diabetic and normoglycemic groups with statistically significant increase in diabetic patients compared to normoglycemic group and this mean that hyperglycemia in ICU and worsen the APACHE II score increase the mortality and duration of hospital stay. From all the above We can conclude that the stress hyperglycemia is significantly prevalent in medical ICU of Zagazig University Hospitals with highest figures among patients with cardiovascular and cerebrovascular emergencies. Also there are many risk factors that may increasing the risk of occurrence of stress hyperglycemia in stressful conditions more than others the most risky one was positive family history followed by increased systolic blood pressure,

BMI, then increasing the age and APACHE II score level, finally stress hyperglycemia in ICU and worsen the APACHE II score increase the mortality and duration of hospital stay of Medical ICU subjects. Therefore strict control of stress hyperglycemia is recommended to decrease mortality and hospital stay in ICU.

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4/24/2013