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CRITICAL CARE MANAGEMENT OF STRESS INDUCED HYPERGLYCEMIA IN GENERAL MEDICINE - A PROSPECTIVE STUDY

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ABSTRACT Stress induced hyperglycaemia (SIH) poses a significant challenge in the management of critically ill patients in the Intensive Care Unit (ICU). ICU patients often experience a dysregulation of blood glucose levels due to the physiological stress response triggered by severe illness, trauma, or surgery. A prospective observational analysis was conducted to study the management of stress induced hyperglycaemia in general medicine in ICU patients at Government Cuddalore Medical College and Hospital a 1250 bedded Multi-Speciality Tertiary Care Teaching Hospital Located in Chidambaram. A total of 30 cases were taken from November 2023 to February 2024.The collected data were analysed by descriptive statistical analysis method. Out of 30 cases around 83% were male remaining 17% were female patients admitted with the similar complaints of chest pain, breathlessness, palpitation. With an increased Capillary Blood Glucose (CBG) of around 220 to 350 mg/dl. The patient Capillary Blood Glucose level came to normal within 5 days for majority of patients without Insulin administration. The patient's with increased blood glucose due to stress normally have some type of cardiac related problems.

KEYWORDS : Chest pain, CBG, Cardiac related problems.

INTRODUCTION

Stress-induced hyperglycaemia (SIH) poses a significant challenge in the management of critically ill patients in the Intensive Care Unit (ICU). ICU patients often experience a dysregulation of blood glucose levels due to the physiological stress response triggered by severe illness, trauma, or surgery. This hyperglycaemic state, if left unmanaged, can have profound implications on patient outcomes, including increased morbidity, prolonged hospital stay, and higher mortality rates.

Hyperglycaemia during critical illness is common and associated with increased mortality. Intensive insulin therapy has improved outcomes in some, but not all, intervention trials. It is currently unclear whether the benefits of treatment differ among specific patient populations.[1]

The intricate relationship between stress, the endocrine system, and glucose metabolism underscores the importance of vigilant monitoring and effective management strategies for stress-induced hyperglycaemia. As healthcare professionals navigate the complexities of caring for critically ill patients, addressing hyperglycaemia becomes integral to holistic patient care and optimizing clinical outcomes.

Stress hyperglycaemia is common and likely to be associated with at least some of the same complications as hyperglycaemia in true diabetes mellitus, such as poor wound healing and a higher infection rate. The predominant cause is the intense counterregulatory hormone and cytokine responses of critical illness, often compounded by excessive dextrose administration, usually as TPN.[2]

This introduction aims to explore the multifaceted aspects of stress-induced hyperglycaemia in the ICU setting, emphasizing the need for a comprehensive approach to its management. From understanding the underlying mechanisms that contribute to hyperglycaemia to implementing evidence-based interventions and monitoring techniques, this discussion will delve into the evolving landscape of stress-induced hyperglycaemia management in the ICU. As the healthcare community continues to advance in its understanding and application of best practices, it becomes imperative to explore current guidelines, therapeutic modalities, and emerging trends in order to enhance the quality of care provided to critically ill patients in the ICU.

Hyperglycaemia, hypoglycaemia, and increased glycaemic variability have each been independently associated with increased risk of mortality in critically ill patients. The role of diabetic status on modulating the relation of these three domains of glycaemic control with mortality remains uncertain. The purpose of this investigation was to determine how diabetic status affects the relation of hyperglycaemia, hypoglycaemia, and increased glycaemic variability with the risk of mortality in critically ill patients.[3]

The optimal target for blood glucose levels can vary depending on individual factors, such as age, overall health, and the presence of any underlying medical conditions, particularly diabetes. Generally, blood glucose targets are often established to prevent complications and promote overall well-being. Here are some general guidelines:

For individuals with diabetes, optimal blood glucose targets may differ, and they are often individualized based on factors such as age, overall health, and the presence of complications. Here are general recommendations:

1. **Fasting Blood Glucose:**
   - Target levels for fasting blood glucose in people with diabetes are often in the range of 80-130 mg/dL.
2. **Postprandial (After Meals) Blood Glucose:**
   - Target levels for blood glucose two hours after meals are typically recommended to be below 180 mg/dL.
3. **HbA1c (Glycated Haemoglobin):**
   - Target HbA1c levels for people with diabetes vary, but values below 7% are often recommended to reduce the risk of complications.

It's crucial for individuals with diabetes to work closely with their healthcare team to establish personalized blood glucose targets based on their specific health status and goals. Regular monitoring, lifestyle adjustments, and medication management are essential components of maintaining

optimal blood glucose control. Always consult with a healthcare professional for personalized advice and guidance.

Study About Glycemic Variability

Glycaemic variability refers to the fluctuations in blood glucose levels over time. Studying glycaemic variability is essential, especially in the context of diabetes management, as it provides valuable insights into the stability and control of blood sugar levels. Here are key aspects of the study of glycaemic variability:

1. **Measurement:**
- Glycaemic variability is measured using continuous glucose monitoring (CGM) systems, which provide real-time data on blood glucose levels throughout the day and night. Traditional methods such as self-monitoring of blood glucose (SMBG) may not capture the dynamic changes in glucose levels as effectively.

2. **Parameters:**
- Various parameters are used to assess glycaemic variability, including standard deviation (SD), mean amplitude of glycaemic excursions (MAGE), coefficient of variation (CV), and more. These parameters help quantify the degree and frequency of fluctuations in blood glucose.

3. **Clinical Significance:**
- Elevated glycaemic variability has been associated with an increased risk of complications in diabetes, including cardiovascular disease, neuropathy, and retinopathy. It may also contribute to hypoglycaemia and impact overall quality of life.

4. **Factors Influencing Glycaemic Variability:**
- Several factors can contribute to glycaemic variability, including meal timing and composition, physical activity, stress, medication adherence, and the individual's response to insulin.

5. **Impact on Diabetes Management:**
- Understanding glycaemic variability is crucial for optimizing diabetes management. Healthcare providers can use this information to adjust treatment plans, medication dosages, and lifestyle recommendations to achieve more stable blood glucose levels.

6. **Research and Clinical Trials:**
- Ongoing research focuses on the relationship between glycemic variability and diabetes-related complications. Clinical trials may investigate interventions aimed at reducing glycaemic fluctuations and improving overall glucose control.

7. **Technology Advancements:**
- Advances in glucose monitoring technology, including the development of advanced CGM systems, enable more accurate and comprehensive assessments of glycaemic variability. These technologies may provide a more detailed understanding of glucose patterns and aid in personalized diabetes care.

8. **Patient Education:**
- Educating individuals with diabetes about the importance of glycaemic variability and empowering them to recognize patterns in their glucose levels can lead to better self-management and improved outcomes.

Continuous glucose monitors (CGMs) have suddenly become part of routine care in many hospitals. The coronavirus disease 2019 (COVID-19) pandemic has necessitated the use of new technologies and new processes to care for hospitalized patients, including diabetes patients. The use of CGMs to automatically and remotely supplement or replace assisted monitoring of blood glucose by bedside nurses can decrease: the amount of necessary nursing exposure to COVID-19 patients with diabetes; the amount of time required for obtaining blood glucose measurements, and the amount of personal protective equipment necessary for interacting with patients during the blood glucose testing.[4]

In recent years, stress hyperglycaemia ratio (SHR) has been proposed as a better index of relative stress hyperglycaemia, which is calculated from admission glucose adjusted for chronic glycaemic status using glycosylated haemoglobin (HbA1c).[5]

In summary, the study of glycaemic variability is a dynamic field that plays a crucial role in advancing our understanding of diabetes management. By exploring the nuances of blood glucose fluctuations, healthcare professionals can tailor interventions to optimize glycaemic control and mitigate the risk of complications in individuals with diabetes.

Objectives

- To study the importance of measuring HbA1c level in all patients admitted in ICU with CBG > 140 mg/dl.
- To analyse the drug prescribed for stress induced hyperglycaemia in Intensive Care Unit.
- To study the duration of stay for patients with stress induced hyperglycaemia.

MATERIALS AND METHODS

Study Setting

- Hospital based study in ICU patients at Government Cuddalore Medical College and Hospital, a 1250 bedded Multi-Speciality Tertiary Care Teaching Hospital Located in Chidambaram.

Study Period

- 4 months [Nov 2023- Feb 2024]

Study Design

- Prospective observation study.

Study Tools

- Google form.

Study Population

- The study method includes selection of participants based on inclusion and exclusion criteria.

Inclusion Criteria

Patients admitted in ICU with,
- Age ≥ 18 years
- Random CBG ≥ 140 mg/dl

Exclusion Criteria

- Patients with known case of DM

Sample Size

- 30 population.

Observations And Findings

A total of 30 cases were given.

Age Wise Distribution Of Patients

Table: 1

AGE	NO. OF PATIENTS	PERCENTAGE
45-50	3	10%
51-55	7	23%
56-60	8	27%
Above 60	12	40%

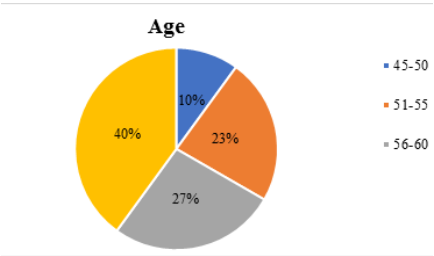

Figure: 1.

From the above observation, the patient above 60 years of age had stress induced hyperglycaemia (40%) and 56-60 years of age (27%), 51-55 years of age (23%), 45-50 years of age (10%).

Gender Wise Distribution Of Patients

Table: 2

GENDER	NO. OF PATIENTS	PERCENTAGE
Male	25	83%
Female	5	17%

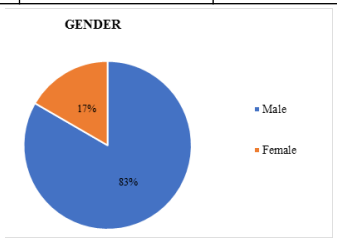

Figure: 2

From the above observation, majority of patients having the condition were male 83% with female only 17%.

Duration Of Hospital Stay

Table: 3

DURATION	NO. OF PATIENTS	PERCENTAGE
5	4	13%
6	6	20%
7	8	27%
8	10	33%
Above 8	2	7%

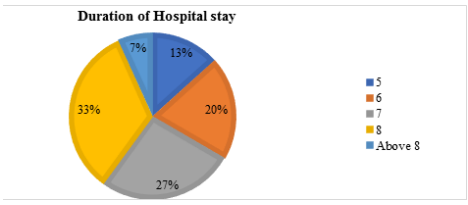

Figure: 3

From the above observation, around 10 patients stayed for 8 days (33 %), 8 patients stayed for 7 days (27%), and 6,4,2 patients stayed for 6,5, above 8 (20%, 13%, 7% respectively).

Chief Complaints Of The Patients

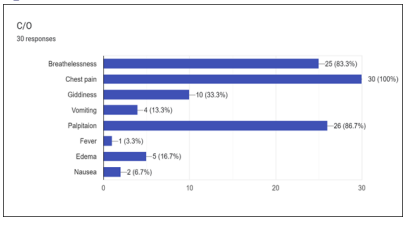

Figure: 4

From the above observation, all the patients came with chest pain had stress induced hyperglycaemia (100%). Hyperglycaemia in patients with breathlessness (83.3%), palpitation (86.7%) and giddiness, vomiting, fever, oedema, nausea were minor complaints.

Cbg Charting Of The Patients

Table: 4

	NO. OF PATIENTS		
CBG	DAY 1	DAY 2	DAY 3
Below 140	0	9	17
140-150	3	3	4
151-200	5	4	3
201-249	9	8	6
250-299	8	3	0
300-350	5	3	0

From the above observation, 9 patients (majority) came with CBG (201-249).Blood glucose level came to normal within 3 days for 17 patients (below 140).

Hba1c Level Of The Patients

Table: 5

HbA1c	NO. OF PATIENTS	PERCENTAGE
>6.4%	22	63%
<6.4%	8	27%

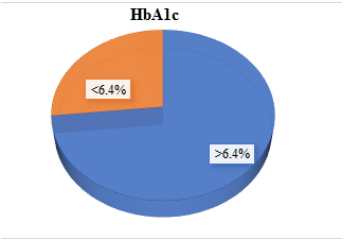

Figure: 5

From the observation, 22 patients had HbA1C value >6.4% (63 %) and 8 patients had HbA1c <6.4% (27%).

Diagnosis Of The Patients

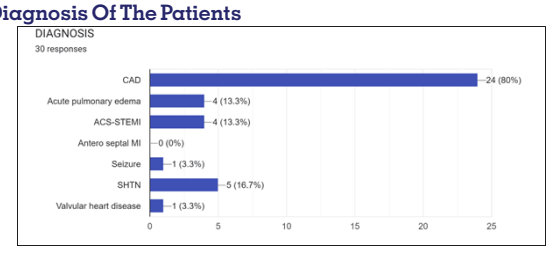

Figure: 6

From the above graph, patients diagnosed with Coronary Artery Disease had stress induced hyperglycaemia condition with 80% and remaining diagnosis like acute pulmonary oedema, ACS-STEMI, seizure, SHTN, Valvular heart diseases in minor range.

Drug Administration

From the study, increased blood glucose level in majority of patient's has reversed after 3 days without drug therapy. The patients were monitored continuously. Among 30 patients only 9 patients received drug therapy to reduce the blood glucose level using regular insulin.

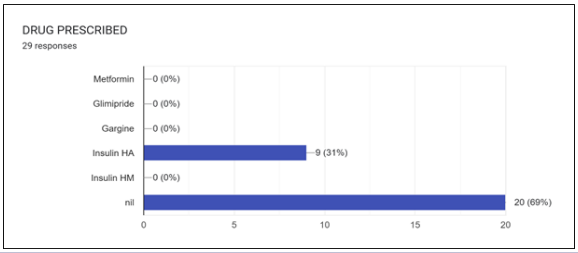

Figure: 7

Discharge Plan

Prior to being discharged from the hospital, the patient's blood glucose levels were brought under control. They were advised to undergo annual diabetes screenings and received proper guidelines including nutritional therapy, physical activities and smoking cessation, all aimed at preventing the progression to pre-diabetes and diabetes.

Limitation

Limitation of the prospective observational study include:

- Small sample size.
- Study carried out at a single centre.

DISCUSSION

Based on our study, patients with CBG levels greater than 140 mg/dl were included, and their HbA1c levels were assessed. The majority of the patient's blood glucose levels normalized without requiring any drug therapy. Continuous monitoring of CBG levels was conducted, and if levels increased, they were controlled using short-acting insulin. The duration of hospital stay for patients varied between 5 to 8 days, depending on their chief complaints. Stress-induced hyperglycemia typically resolved within 3 days for most of the patients. The study conducted by Falciglia et al[1] suggests a link between hyperglycaemia and mortality in critically ill patients, indicating that hyperglycaemia could be a harmful and modifiable factor in this population. However, our study couldn't show any similar inference may be due to limited sample size". The study by Vedantam D et al[6],sheds light on the intricate interplay between cytokines, hormones, insulin resistance, and glucose production, particularly in critically ill patients. Their research underscores the importance of closely monitoring blood glucose levels and utilizing insulin therapy as a treatment strategy, which has been shown to significantly enhance patient outcomes. Our study appears to complement theirs, indicating a synergistic relationship between the findings. This mutual reinforcement strengthens the finding by supporting the effectiveness of intravenous insulin infusion in managing glucose levels among critically ill patients. It emphasizes the necessity of establishing tailored glucose management targets based on individual patient illness severity and the vital role of routine monitoring in achieving these targets and optimizing outcomes. Our study findings align with those of Rajpurohit et al[5], indicating that stress-induced hyperglycemia (SIH) poses a considerable risk for adverse clinical outcomes in patients with coronary artery disease (CAD) and myocardial infarction (MI), regardless of their diabetic history or previous glycemic control. Importantly, our research underscores that individuals without a prior diabetic diagnosis were susceptible to SIH in the context of CAD and MI, highlighting the significance of addressing hyperglycemia in this patient population to improve clinical outcomes.

CONCULSION

Based on the study, it was observed that male patients, particularly those with cardiac-related issues, were more prone to stress-induced hyperglycemia compared to female patients. The majority of patients with this condition experienced a hospital stay lasting between 5 to 8 days, after which they were discharged once their chief complaints resolved. Hyperglycemia was typically monitored without drug therapy for three days, with most of the patients showing a reversal of the condition within this timeframe. If hyperglycemia persisted, patients were then treated with regular insulin therapy. Additionally, patients above 40 years of age, even without a history of diabetes, should undergo annual blood glucose level checks to detect hyperglycemia early and prevent the onset of pre-diabetes or diabetes.

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