Section: General Medicine

Original Research Article

A STUDY ON STRESS HYPERGLYCEMIA IN MODERATE DEGREE BURNS

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ABSTRACT

Background: Stress hyperglycemia is a transient event, but it has its own morbidity and mortality. In this study, we saw the prevalence of stress hyperglycemia in moderate degree burns and its impact on patient outcome. **Materials and Methods:** This analytical cross-sectional study included 150 patients admitted with 15–30% total body surface area (TBSA) burns at Sri Venkateshwaraa Medical College Hospital and Research Centre, Puducherry, over 19 months (March 2024–October 2025). Patients with pre-existing diabetes, severe burns (>30%), gestational diabetes, or other comorbidities were excluded. Blood glucose (random, fasting, and postprandial) and HbA1c were measured to diagnose stress hyperglycemia as per ADA criteria. Clinical parameters, duration of hospital stay, infection profile, and mortality were analyzed.**Result:** Among 150 patients, 133 patients were stress hyperglycemic, and 17 were newly diagnosed with diabetes. Stress hyperglycemia caused a longer duration of stay >15 days, p-value (0.009). Males had a longer duration of stay, p-value (0.034). It was more common among young females aged less than 30 years, p-value (0.048). More common among the younger age group. Non-pseudomonas organisms (Staphylococcus, Klebsiella, Proteus, etc) were the most common organisms found, p-value (0.005. Staphylococcus was the common single organism, and Staphylococcus and Klebsiella were combined organisms. The hyperglycemic sugar range was 200-250mg/dl. Non-pseudomonas organisms were more in the younger age group, p-value (0.005. No mortality was seen in stressful hyperglycemic patients. Mortality was seen in three patients who were diabetic, and they were infected with a combined organism. **Conclusion:** Thus, from the study, we see that stress hyperglycemia causes increased morbidity in the form of longer duration of stay, infection, and affects the younger age group. 17 new diabetic cases were detected.

INTRODUCTION

Stress hyperglycemia (also known as stress diabetes or injury-related diabetes) is a temporary increase in blood glucose levels caused by any form of illness or stress. It typically resolves on its own, but it must be distinguished from various types of diabetes mellitus. Stress hyperglycemia reflects a state of reduced insulin secretory capacity or decreased insulin sensitivity and serves as an initial indication of potential developing diabetes.[1-5]

It occurs in an acute stressful state, which includes stroke, burns, myocardial infarction, and any critical illness. It's due to the overactivity and overproduction of counterregulatory hormones. Burns are a highly acute stressful state, caused by heat, electricity, chemicals, light, radiation, or friction. Following the injury, there appear to be varied metabolic changes, which include energy expenditure, protein breakdown, which is elevated, and alterations in fat metabolism.[6-10]

Insulin resistance is the major factor for all effects, because more data have shown insulin resistance and its association with liver function derangement as a cause for increasing the morbidity and mortality, which is seen in burned patients. The metabolism of fat is altered postburn, which is related to changes in insulin resistance. The high sugar alters the outcome in burns in the form of graft uptake and sepsis. There are few studies regarding burns and their hyperglycemia, either due to stress or diabetes. Therefore, this study aims to find hyperglycemia due to stress or diabetes in burns and its outcome.[11]

Aim of Study

To find out the prevalence and outcome of stress hyperglycemia in moderate degree burns patients.

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MATERIALS AND METHODS

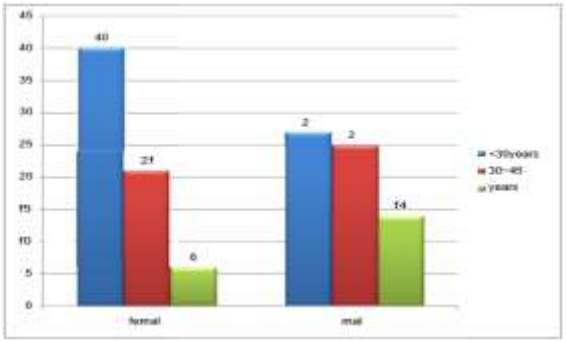
Setting: Burns Department in Sri Venkateshwaraa Medical College Hospital and Research Centre, Ariyur, Puducherry.
Design of Study: Analytical cross-sectional study
Period of Study: 19 months (March 2024-October 2025)
Inclusion criteria
A total of 150 patients who were admitted to the burns department in Venkateshwaraa Medical College were taken up for the present study. Patients with moderate degree burns (15-30%) were selected for the study. Patients were seen with random blood sugar, three-day fasting sugar and postprandial sugar, and HbA1c. Patients were diagnosed with DM as per the American diabetes association criteria.
ADA criteria are as follows:
a. Fasting plasma glucose>=126mg/dl
b. 2 Hour plasma glucose>=200mg/dl
c. Random blood sugar >=200mg/dl
d. HbA1c>=6.5%
Exclusion criteria
Since it is a study of stress hyperglycemia, patients already known diabetics were excluded from the study. Severe burn patients were also excluded since mortality was high. Females with a history of gestational diabetes were also excluded. Patients aged < 18 years and other comorbid conditions, and taking steroids were excluded.

RESULTS

In the present study, a total of 150 patients were selected according to inclusion criteria, from the 700-800 patients admitted in the burns department with moderate degree burns in one year. Diabetes was ruled out in them by seeing HbA1c, and observations made subsequently. The total number of males and females in the study was 72 and 78. Among them, newly detected diabetes cases were 17 in the study. Since it is a study about stress hyperglycemia, diabetes was ruled out, and the remaining 133 patients were taken to study. The total number of males and females with stress hyperglycemia was 67, and males was 66. Among them, people were grouped into three age groups: those who are < 30 years, 30-45 years, and more than 45 years. Their duration in hospital was divided into lesser durations of 15 days or longer than 15 days.
The following observations were made subsequently:
Sex and Age Group: The number of male and female patients in each age group was first Seen.

Table 1

Sex	Age group			
	<30 years	**30-45years**	**>45 years**	**Total**
Female	40	21	6	67
%	59.7%	31.3%	9.0%	100.0%
Male	27	25	14	66
%	40.9%	37.9%	21.2%	100.0%
Total	67	46	20	133



The study shows a larger number of patients in the < 30 years age group in both males and females, and patients in the 30-45years with burns were almost equal. But in the older age group, males are more than Females. The chi-squared significance between them is 6.063, p-value = 0.048. There is a sex and age group in stress hyperglycemia.

Sex and hospital days: The sex and hospital days observed are as follows.

Table 2

SEX	Hospital days		
	<15 days	**>15days**	**Total**
Female	23	44	67
%	34.3%	65.7%	100.0%
Male	12	54	66
%	18.2%	81.8%	100.0%
Total	35	98	133

In both the sex more number are found in a longer duration of stay in >15days. In females, 44/67 and in males, 54/66 are found in a longer duration of stay.
Comparison between Sex and Hospital Days

The chi-square and p-value are 4.4070 and p=0.034. There is statistical Significance between the duration of days and sex. From the study, it is seen that longer duration days are seen more in both males and

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females, but males are 54/67 with 81.8%, so males with stress hyperglycemia have a longer stay.
From the study, it is seen that the overall distribution of sex in stress hyperglycemia is 67/133 females and 66/133 males. The sugar range for stress hyperglycemia was grouped into a lower range of <250mg/dl and a higher range of>250mg/dl.

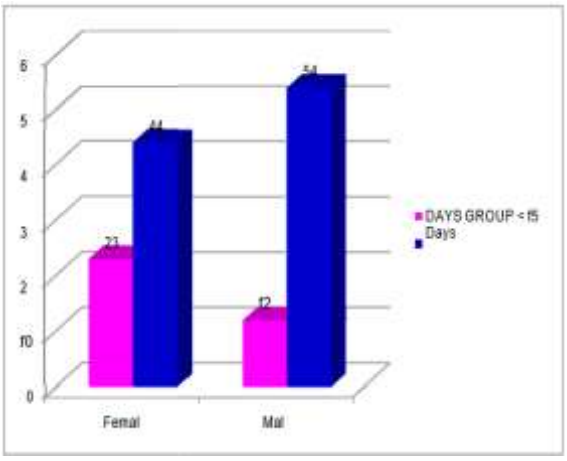
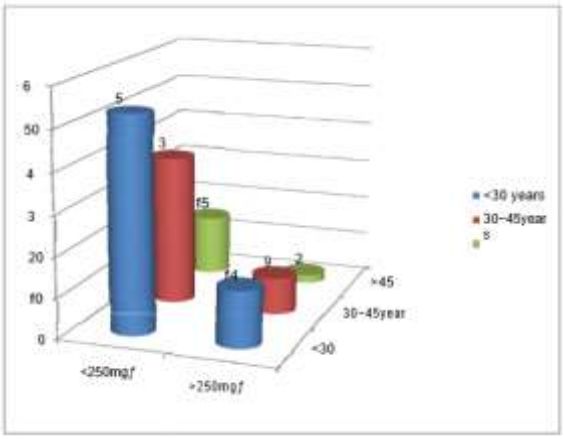


Table 3: Sex and Stress Hyperglycemia:

Sex	Stress hyperglycemia		
	<250mg/dl	**>250mg/dl**	**Total**
Female	56	11	67
	83.6%	16.4%	100.0%
Male	49	17	66
	74.2%	25.8%	100.0%
Total	105	28	133

Table 4: Stress hyperglycemia and age group.

STRESS HYPERGLYCEMIA	AGE GROUP			
	<30 years	**30-45 years**	**>45 years**	**Total**
<250mg/dl	53	37	15	105
%	50.5%	35.2%	14.3%	100.0%
>250mg/dl	14	9	5	28
%	50.0%	32.1%	17.9%	100.0%
Total	67	46	20	133



Comparison between stress hyperglycemia and the age group showed a higher number in <250mg/dl sugar, around 105/133, and around 28/133 in >250mg/dl.
The younger age group <30 years was around 53/105 and had sugar in the range of <250mg/dl.
Comparison between Stress Hyperglycemia and Age Groups
The above figure shows that stress hyperglycemia is more in the statistically
The Younger age group is around 50.5%. And sugar is also in the range <250mg/dl.
The chi-square is -0.250 and the p-value is -0.883, which is not significant.

Stress Hyperglycemia and Hospital Days: -

The sugar value was taken has two groups with sugar <250mg and those with sugar >250mg. The sugar value and hospital days observed in the study are as follows:

Table 5

Stress hyperglycemia group	Hospital days		
	< 15 Days	> 15 Days	Total
< 250 mg/dl	34	76	110
%	30.9%	69.1%	100.0%
> 250 mg/dl	1	22	23
%	4.3%	95.7%	100.0%
Total	35	98	133

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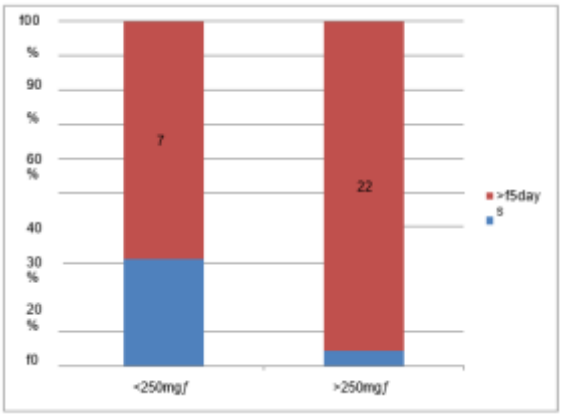


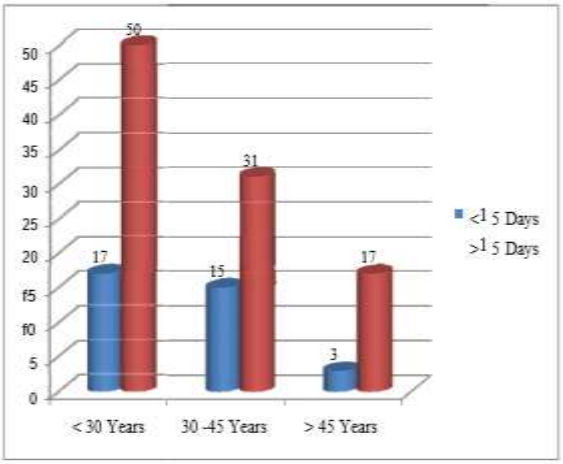
Around 110 patients had sugar <250mg/dl, and among them, 76/110 were found to have in longer duration of stay. More than 250mg/dl sugar was found in 23 patients, and among them, 22 had a longer duration of stay.

Comparison between Stress Hyperglycemia and Hospital Days

The total patients with sugar values less than 250 was 110/133, and among them, 76 had a longer duration of stay, which accounts for 69.1% and more than 250 was 23/133, and among them, 22 had a longer duration of stay, which is 95.7%. The chi-square was 6.921 and the p-value - 0.009, which was statistically significant.

Table 6: Age and hospital days

DAYS	AGE GROUP			
Years	**< 30 Years**	**30 -45 Years**	**> 45 Years**	**Total**
< 15 Days	17	15	3	35
%	48.6%	42.9%	8.6%	100.0%
> 15 Days	50	31	17	98
%	51.0%	31.6%	17.3%	100.0%
Total	67	46	20	133



The analysis between the hospital days and age group showed a larger number in the longer duration of stay, 98/133, as compared to lesser duration, on which was 35/133.

The longer duration of stay was found to be higher among younger age groups who are less than 30 years of age, around 50/67, which is around 74.62%.

Comparison between Age and Hospital Days

The above table and diagram show the observation between ages.

And hospital days. It is seen that in all age groups, a larger number have longer duration of stay, but the younger age group, <30 years, is around 50, and has a longer duration of stay. There was no statistical significance.

Mortality and hospital days: Since only 3 deaths and all three were diabetic, mortality and hospital days were seen for all 150 patients. It was observed longer duration of stay was not associated with mortality.

Table 7

Out come	Days group		
	<15 days	**>15 days**	**Total**
Alive	35	112	147
%	23.8%	76.2%	100.0%
Death	2	1	3
%	66.7%	33.3%	100.0%
Total	37	113	150

Among the 3 who died, 2/3 had shorter duration of stay, and only one had a longer duration of stay. It was not statistically significant.

Comparison between Mortality and Hospital Days

There was no death in stress hyperglycemic patients in this study. Mortality was seen in 3 patients, but all three patients were diabetic.

Table 8: Organisms and Age Group:

ORGANISM GROUP	AGE GROUP			
	<30years	**30-45years**	**>45 years**	**Total**
Pseudomonas	6	5	7	18
%	33.3%	27.8%	38.9%	100.0%
Non pseudomonas	57	38	13	108
%	52.8%	35.2%	12.0%	100.0%

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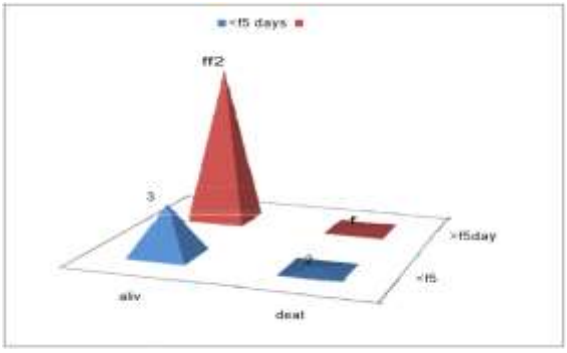
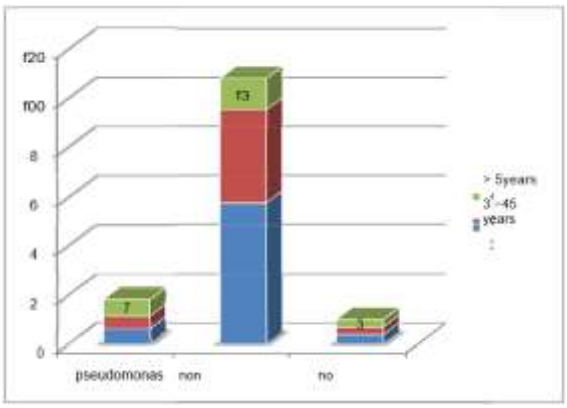
No growth	4	3	0	7
%	57.1%	42.9%	.0%	100.0%
Total	67	46	20	133



As seen, there were more non-pseudomonas organisms, and among them, younger individuals had more infections with non-pseudomonas organisms. Infection is always found in the older age group. There was no older age without an organism infection.



Comparison between Organisms and Age Groups

From the study, as already seen, non-Pseudomonas organisms were higher, and their distribution was also higher in the younger age group. Younger individuals are having non-Pseudomonas infections more commonly.

DISCUSSION

Burn injury results in a complex physiological stress response that includes hypermetabolism, catabolism, and endocrine dysregulation. Among the earliest and most constant responses to injury is the development of stress hyperglycemia, a transient elevation in blood glucose resulting from an excessive release of these counter-regulatory hormones, such as cortisol, catecholamines, glucagon, and growth hormone. These stress hormones stimulate hepatic gluconeogenesis, suppress peripheral glucose uptake, and induce insulin resistance. In fact, in the current study involving 150 patients with burns within the range of 15-30% TBSA, as many as 133 patients (88.6%) developed stress hyperglycemia, suggesting that glucose dysregulation is almost a universal metabolic consequence of burn injury.

There was a statistically significant correlation between stress hyperglycemia and extended hospitalization of more than 15 days ($p = 0.009$). These findings agree with those of Stoecklin et al. (2015) and Wang et al. (2023), which showed that hyperglycemia increases the recovery time by delaying wound healing, reducing graft uptake, and predisposing one to infection. High glucose levels impede neutrophil chemotaxis, phagocytosis, and bactericidal activity, promoting microbial proliferation. Hyperglycemia also enhances oxidative stress and the release of pro-inflammatory cytokines that prolong tissue repair.

Although stress hyperglycemia was seen in all age groups, it was more common among the younger patients (<30 years) and more significantly so among females, $p = 0.048$. This could be related to sociocultural and occupational exposure patterns, such as domestic flame injuries in young women, combined with physiological differences in stress hormone responses. In the analysis for hospital stay by sex, male patients had a longer duration of stay, $p = 0.034$. This may be related to larger surface area burns, deeper burns, or gender differences in pain tolerance and compliance with rehabilitation.

The infection profile from this study gives further insight into the clinical implications of stress hyperglycemia. Non-Pseudomonas organisms, mainly Staphylococcus aureus, Klebsiella pneumoniae, and Proteus species, were significantly higher ($p = 0.005$). This was similarly reported in a study by Hallman et al. (2023), who stated that hyperglycemia favors the colonization of Gram-positive bacteria due to poor neutrophil function and an altered wound environment. Curiously enough, Pseudomonas aeruginosa, usually dominant in severe burns and in the ICU, was less frequent in our moderate-burn cohort. It can be explained by good wound hygiene, early surgical interventions, and fewer uses of invasive devices in moderate burns.

Importantly, no mortality occurred among stress hyperglycemic patients, with three deaths occurring among the known or newly diagnosed diabetics, each having polymicrobial infections. This difference supports the hypothesis advanced by Li et al. (2024) and Arellano et al. (2025) that stress hyperglycemia, although transient, is fundamentally different from diabetic hyperglycemia in the long-term ramifications. Chronic diabetics manifest microvascular compromise, poor wound perfusion, and chronic immune dysfunction, leading to worse outcomes. Stress hyperglycemia reflects an adaptive but perhaps maladaptive metabolic response, which is reversible with clinical recovery.

The present study also underlines that non-Pseudomonas infections were common in the younger age group, which again points out the association of transient hyperglycemia with infection

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and delayed recovery. These are most likely secondary to the immunosuppressive effect of hyperglycemia and prolonged hospital stay rather than burn size alone. This observation suggests that early glycemic control, even in patients without diabetes, may be an important strategy to reduce infectious morbidity and hospital costs.

Such an absence of mortality among stress hyperglycemic patients in this study runs in contrast to several ICU-based studies that have documented higher mortality with uncontrolled hyperglycemia. This may be explained by the exclusion of severe burns (>30% TBSA) from our sample, as mortality correlates more with burn severity and systemic inflammatory burden rather than with glycemia alone. Nonetheless, stress hyperglycemia should be regarded as a prognostic indicator of morbidity and prolonged recovery rather than a benign adaptive mechanism. Glucose monitoring should be routine in all burn patients, irrespective of their diabetic status. Early nutritional optimization, infection surveillance, and cautious use of insulin therapy may reduce morbidity. However, as Stoecklin et al. (2015) and Wang et al. (2023) have warned, overly aggressive insulin regimens risk hypoglycemia, which may worsen outcomes. Thus, moderate glycemic control appears to be optimal, maintaining blood glucose between 140-180 mg/dl. The limitations of the present study include its cross-sectional design, single-center setting, and lack of continuous glucose monitoring, which might underestimate the glycemic variability. Assessment of cytokine profiles, insulin levels, and long-term follow-up was not done. Larger studies with longitudinal follow-up in the future will help to establish whether stress hyperglycemia predisposes to future diabetes mellitus.

CONCLUSION

- The stress hyperglycemic patients observed in this study are 133/150, which is around 88.6%.
- Newly detected diabetes from the study is 17, with an 11.3% incidence.
- The sugar range for stress hyperglycemia was between 200- 250 mg.
- Stress hyperglycemic patients have a longer duration of stay.
- Males with stress hyperglycemia had a longer duration of stay.
- Stress hyperglycemia is higher among the younger age group, which is less than 30 years old.
- Stress hyperglycemia is more common among young females compared to males. 52% females had stress hyperglycemia.
- Stress hyperglycemia showed more non-Pseudomonas organisms.
- Non-pseudomonas organisms are more common in the younger age group.
- Non-pseudomonas organisms in stress hyperglycemia were found in the sugar range of <250 mg/dl.
- Non-Pseudomonas organisms showed longer duration of stay.
- The common single organism found in the study is Staphylococcus.
- The common combined organism found in the study is Klebsiella and Staphylococcus
- Mortality was found in diabetic patients with combined organism infection.
- No Mortality in stress hyperglycemia.

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