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Original Research Article

PROFILE OF HYPERGLYCAEMIC EMERGENCIES PRESENTING IN EMERGENCY DEPARTMENT: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Hyperglycemia caused by diabetes are commonly treated in hospital emergency departments. Physicians must be skilled in diagnosing and stabilizing patients with these conditions. Diabetic Keto Acidosis and Hyper osmolar Hyper Glycemic State are best treated with standardised protocols that specifically address electrolyte repletion, insulin dosing, and fluid management. Mortality in both DKA and HHS is often related to underlying comorbidities and the precipitating insult. Aim of the study was to measure the occurrence of hyperglycaemic emergencies presenting to the Emergency Department, the factors associated and its outcome.

Materials and Methods: All patients >18yr presenting to Emergency Department, RBS was checked in the initial triage room and patients were triaged according to clinical condition. In ED all patients were then evaluated and those who fulfilled the criteria were enrolled in the study. Selected patients were explained about the study and Written Informed consent was taken from all the participants. Socioeconomic, clinical, and laboratory data and patient's respective outcomes were extracted from the data obtained. Statistical analysis was done using SPSS Version 22.

Results: This study has demonstrated the variable epidemiology of hyperglycaemic emergencies with DKA being most common and HHS least common. Longer in-hospital stay and associated mortality are major issues with hyperglycaemic emergencies.

Conclusion: Patient who arrives in the ER with high blood sugars can be risk stratified early and aggressive management can be instituted in the Emergency Room itself. This will help in preventing long term complications for the patients.

Keywords: Diabetic emergencies, diabetic keto acidosis, hyper osmolar hyperglycaemic state, mortality, length of hospital stay.

INTRODUCTION

Diabetes mellitus is a common metabolic disorder which presents to the emergency department with life threatening emergencies which are important contributors to morbidity and mortality. The two most common manifestations include Diabetic ketoacidosis (DKA) and Hyperosmolar Hyperglycaemic States (HHS).[1] Such emergencies constitute an increase in the incidence of patients being handled by the emergency medical services across the globe.[2]

Diabetes is a major challenge for a resource-limited country like India. An Indian study, says India, once known as the 'Diabetes capital of the world' was home to 61.3 million patients with type2 diabetes mellitus in 2011; with predictions of 101.2 million diabetics by 2030.[3,4] In developing countries, mortality due to both of these are estimated at around 20-30%.[1,5] They are also economically burdensome because of the need for longer hospital stays and management of other complications, which may occur during the stay. Therefore, it becomes vital that the health professional, especially in the emergency

room, be able to manage the hyperglycaemic crisis associated with diabetes.

In 2015, the Royal Australasian College of Physicians, concluded that in patients who were newly diagnosed as diabetics, the admission blood glucose level at emergency department was independently associated with increased mortality.[6]

In 30% of affected adults, Diabetes mellitus is undiagnosed. Prevalence varies depending on geography, age, sex and race and is rising globally with a greater increase in developing countries.[7]

In United States, it has been noted that Diabetes is leading cause of blindness, end stage renal disease and nontraumatic lower limb amputations and also predisposes to microvascular and macrovascular complications in persons with type2 DM.[8,9]

Mortality rate in treated DKA is approximately 5-7% and in treated HHS patients has been 40-70% in past but now ranges from 8-25%.[10] The primary causes of death remain infection, especially shock, pneumonia and arterial thrombosis. This decrease in mortality rate has demonstrated that appropriate therapy can make a difference. Cerebral oedema, less common in adults, generally occurs 6 to 10 hours after the initiation of therapy. There are no warning signs, and the associated mortality is as high as 90%.[11]

Due to its increasing incidence and economic impact related to the treatment and associated morbidity, effective management and prevention is key. Prevention strategies in emergency department include educating patient and their relatives regarding all aspects of the disease and the associated risk factors.

Many of hyperglycaemic emergencies can be prevented by proper discharge planning including diabetes education, selection of an appropriate insulin regimen that is understood and affordable by the patient and preparation of supplies for the initial insulin administration at home. Sick-day management that includes capillary beta-hydroxybutyrate monitoring along with glucose monitoring, helps to reduce emergency room visits and hospitalization in young people.[12]

We conducted this study to analyse the clinical profile of Hyperglycaemic emergencies presenting in our Emergency Room. We identified the precipitants of such emergencies and its associated comorbidities which will affect outcome of the disease; so that any patient who arrives in the ER with high blood sugars can be risk stratified early and aggressive management can be instituted in the Emergency Room itself. This will help in preventing long term complications for the patients.

MATERIALS AND METHODS

This Cross-sectional observational study was conducted in the emergency department of Bangalore Baptist Hospital Bangalore, which is a tertiary canter and NABH accredited teaching institute. Study Population consisted of patients (>18years) presenting to Emergency Department with hyperglycaemic emergencies. Patients with Pregnancy, trauma, end Stage Renal Disease, history of Congestive Heart Failure, history of Chronic Liver Disease were excluded. Total sample size of the study was 112. Aim of the study was to measure the occurrence of hyperglycaemic emergencies presenting to the Emergency Department, the factors associated and its outcome. We also assessed factors associated and outcome of hyperglycaemic emergencies.

All patients >18yr presenting to Emergency Department, RBS was checked in the initial triage room and patients were triaged according to clinical condition. In ED all patients were then evaluated and those who fulfilled the criteria for Hyperglycaemic Emergencies were enrolled in the study. Selected patients were explained about the study and Written Informed consent was taken from all the participants. Socioeconomic, clinical, and laboratory data and patient's respective outcomes were extracted from the data obtained.

Blood glucose and blood ketones were measured using Freestyle Optium Neo H glucometer (Abbott Diabetes Care Ltd. Range Road, Whitney, Oxon. OX 29 OYL, UK) with Freestyle Optium Neo H blood glucose strips and Freestyle Optium H β Ketone strips. Osmolality was calculated manually [2 Na (mEq/L] + [glucose(mg/dl) /18] + [BUN/2.8]. All the patients were categorised into three study groups (DKA, HHS and Mixed states) based on the presentation and the biochemical parameters. These patients were given fluid bolus with Normal saline and Regular Insulin was considered. Associated precipitants and co morbid conditions were assessed and were admitted to appropriate wards/critical care units based on the initial assessment in ED.

Any critical care interventions done in ED or after admission were observed. Length of stay in hospital was considered from the day of arrival to ED to discharge day. Final outcome in terms of mortality was observed.

Data was entered into Microsoft Excel (Windows 7; Version 2007) and analysis were done using the Statistical Package for Social Sciences (SPSS) for Windows software (version 22.0; SPSS Inc, Chicago). Descriptive statistics such as mean and standard deviation (SD) for continuous variables, frequencies and percentages were calculated for categorical Variables were determined. Association between Variables was analyzed by using Chi-Square test for categorical Variables and ANOVA (Analysis of Variance) was used to compare mean between 3 groups of Diagnosis. Bar charts and Pie charts were used for visual representation of the analyzed data. Level of significance was set at 0.05.

RESULTS

Among 110 patients, observed the mean age was 56.33±12.67 years. The maximum number of patients

were between 50-70 years of age. 59 (53.6%) were male and 51 (46.4%) were female among all participants of the study.

77(70%) patients out of total 110 patients included in the study, were seen to be from rural areas and 33(30%) were from urban areas.

Table 1: Distribution of Study Subjects according to the Diagnosis (n = 110)

Diagnosis	Frequency (n)	Percentage (%)
DKA	95	86.4
HHS	7	6.4
Mixed States	8	7.3

Out of total 110 patients included, 95(86.4%) patients were diagnosed as DKA, 7 (6.4%) were diagnosed as HHS and 8(7.3%) patients were diagnosed as Mixed states.

Table 2: Comparison of Length of Stay in the Study between Diagnosis (n = 110)

Variable	DKA Mean (SD)	HHS Mean (SD)	Mixed States Mean (SD)	Total Mean (SD)	p Value
Length of Stay (Days)	7.64 (5.18)	8.71 (3.90)	9.00 (6.09)	7.81 (5.15)	0.694

The mean length of stay in hospital among 106 admitted patients in the study was 7.81±5.15 days. Among DKA, mean length of stay was 7.64±5.18, HHS it was 8.71±3.9 and in mixed states it was 9±6.09. The difference is statistically insignificant.

Table 3: Association between Associated Infection and Diagnosis (n = 110)

Associated Infection	DKA n (%)	HHS n (%)	Mixed States n (%)	Total n (%)	p Value
Yes	75 (78.9)	4 (57.1)	7 (87.5)	86 (78.2)	0.324
No	20 (21.1)	3 (42.9)	1 (12.5)	24 (21.8)	

86 (78.2%) subjects among all 110 patients have associated infection as precipitants. It was associated with 75(78.9%) subjects with DKA, 4(57.1%) subjects with HHS and 7(87.5%) subjects in Mixed states. The difference was statistically insignificant.

Table 4: Association between Critical Interventions done and Diagnosis (n=110)

Intervention	DKA n (%)	HHS n (%)	Mixed States n (%)	Total n (%)	p value
Definitive Airway	28 (29.5)	1 (14.3)	2 (25.0)	31 (28.2)	0.675
Debridement	3 (3.2)	0 (0.00)	0 (0.0)	3 (2.7)	0.784
Other Aggressive Interventions	4 (4.2)	0 (0.0)	1 (12.5)	5 (4.5)	0.467

Out of 110 patients, definitive airway was secured in 31(28.2%) patients, which included 28(29.5%) subjects of DKA, 1(14.3%) subjects of HHS and 2(25%) of Mixed states (p value 0.675). Debridement of the limbs was done in 3(2.7%) and all were from DKA group 3(3.2%) (p value 0.784). Other aggressive treatments which included procedures like incision and drainage, intercoastal drain etc was done in 5(4.5%) 0f total included patients, which included 4(4.2%) subjects of DKA and 1(4.5%) subjects of Mixed states (p value 0.467).

Table 5: Association between Diagnosis and Outcome (n = 110)

Outcome	DKA n(%)	HHS n(%)	Mixed States n(%)	Total n(%)	p Value
Survived	87 (91.6)	7 (100.0)	8 (100.0)	102 (92.7)	0.506
Died	8 (8.4)	0 (0.0)	0 (0.0)	8 (7.3)	

Out of 110 patients who came to emergency with hyperglycaemic emergencies, 8(7.3%) patients died. Out of 95 patients who were diagnosed as DKA, 8(8.4%) patients died (p value 0.506).

DISCUSSION

All patients (110 subjects) who were included in analysis in our study underwent evaluation and risk stratified at presentation in the ED and were later followed up for their associated length of stay and mortality. Out of 110 subjects, 106 patients were admitted since 4 patients went discharge against medical advice from ED itself.

The mean age of patients in our study was 56.33 years. There is some possible explanation for this. Its all known that DKA is common in type I DM but most of the study population in our hospital was seen to be having type II DM with older age groups. In our study, majority of subjects were from rural group who probably do not get proper counselling for regular routine drug intake at home. Moreover, whenever they feel unwell they often escape their medications. Several cultural and socioeconomic

barriers, such as low literacy rate, limited financial resources and limited access to health care, may explain lack of compliance and why hyperglycaemic emergencies continues to occur in such high rates in rural patients.[13-15]

The study groups have a male predominance, 53.6 % of male and 46.4% of female, with male to female ratio 1.16. This could be explained by the behavioural and lifestyle changes of males in India like moderate-excessive alcohol intake and tobacco use which could lead to poor blood glucose control and precipitation of diabetic emergencies to ED.[16-18]

70% of patients were from rural communities which signifies that acute metabolic complications from uncontrolled DM were more common in this group of people. Hence emphasis should be more on creating awareness among these group of patients about the disease process and prevention of such metabolic complications.[18]

Among our patients, DKA was noted to be the most common hyperglycaemic emergencies presenting to our ED. 86.4% (95) of patients were DKA, 7.3%(98) of the subjects were Mixed states and 6.4%(7) were HHS.[19,20]

The mean total duration of hospital stay was 7.81(±5.15) days. It was maximum in Mixed states as 9(±6.09) days and lowest in DKA states as 7.64(±5.18). In HHS group, it was seen as 8.71(±3.90). The difference was not statistically significant (p value 0.694). This was compared with the mean hospital stay of overall patients in our hospital which is 3.8 days This signifies that patients admitted with hyperglycaemic emergencies to our hospital were having prolonged hospital stay, making hyperglycaemic emergencies economic burdensome for the patients. It consumes more hospital resources and increases the chance of hospital acquired infection. We need to put efforts to prevent such hyperglycaemic emergencies.

Insulin infusion was started in 58.2%(64) of total subjects and it was observed that 41.8%(46) subjects did not receive insulin infusion in ED. In our study, it was seen that mean duration of hospital stay was more those group who did not receive infusion in ED. 8.04(±4.45) days was mean hospital stay in the group who did not receive the insulin bolus and 7.64(±5.64) days in those who received it. This difference is not statistically significant (p value 0.688).

It was seen that 60%(66) of overall subjects received IV fluids more than 2 L and 40%(44) subjects received IV fluid less than 2 L in ED. In our study we saw that overall mortality was more in that group which did not receive IV fluid more than 2 L in ED itself. 4 (9.1%) subjects died in the group who did not receive fluids more than 2L and 4(6.1%) subjects died in the group who received more than 2 L Iv fluid in ED. The difference is not statistically significant (p value 0.549). In our ED, we have different consultants of varying clinical qualifications, who work in different shifts. So, each one of them follow different guidelines for management of hyperglycaemic emergencies, which has resulted in the above varying results. We need to have a specific protocol for treatment so that patient care is not compromised in ED.

The most common precipitants in our study for such emergencies to ED was infection, which was seen in 78.2%(86) of subjects. It was associated with 7, 4 and 7 patients of DKA, HHS and Mixed states respectively. Most of our study participants were from rural areas. They usually have a low-grade infection which is often undertreated at the primary health centre. This precipitates into a life-threatening emergency and they are referred to tertiary care hospital.[15,16]

57.3%(63) of all subjects who came to ED with hyperglycaemic emergencies were not complaint to their routine diabetic medications compared to 42%(42.7) who were taking it properly at home . So, non-compliance to medication was seen as major precipitant of hyperglycaemic emergencies to ED arrival.[17,18]

Although type 2 diabetes mellitus was previously described as the disease of old age but it was seen that younger age groups are likely to present to ED with acute metabolic complications of diabetes mellitus. The percentage of freshly diagnosed diabetes with such complications has been variably reported. Our study result says 8.3%(9) patients who came to ED with hyperglycaemic emergencies were freshly diagnosed as diabetes. So we conclude that a variable and increasing number of patients who do not have diabetes are presenting to ED with acute metabolic complications.[19,20]

Among all 110 patients, the most common associated comorbidity was hypertension, which was seen in 47.7%(52) of patients. It was seen 42, 5, 5 cases of DKA, HHS and Mixed states respectively. These association of CAD or CVA with hyperglycaemic emergencies in our study was either new onset or old comorbidity. CKD was seen 9.1% (10) of subjects, which was differentiated from such hyperglycaemic emergencies in our study by high anion gap metabolic acidosis. 19.1%(21) of patients were associated with other comorbidities which included hypothyroidism, tuberculosis of lung, peripheral vascular disease, rheumatoid arthritis and obstructive sleep apnoea.[21-23]

In our study many patients had more than one precipitating factors like patient who were non-complaint to treatment were also having infection and other stressful situations like ACS, CVA, CKD etc.

One more important aspect of study was seeing that critical care interventions done in how many cases of patients who came to ED with such emergencies. Out of total 110 patients, in 28.2% (31) of cases definitive airway was secured either in ED or in critical care unit after admission. Definitive airway was secured in 29.5%(28) cases of DKA, 14.3%(1)cases of HHS and 25%(2) cases of Mixed states. The difference was not statistically significant (p value 0.675). Debridement was done in patients who had associated cellulitis in overall 2.7%(3) of subjects and all were associated with DKA. Nearly in 4.5%(5)

subjects other aggressive intervention was done, which included incision and drainage, amputation and intercoastal drain. This showed that all such hyperglycaemic emergencies are life threatening events and require prompt treatment.

The overall mortality in our study was 7.3%(8) subjects. It was observed that all mortality was associated with DKA only involving 8.4%(8) patients. This was on an average similar to other studies. In our study out of 8 deaths, 3 deaths were in males and 5 deaths were in females. Mortality was seen in participants who mad more associated comorbidities. So early diagnosis and treatment can avoid morbidity and mortality.[21-23]

CONCLUSION

This study has demonstrated the variable epidemiology of hyperglycaemic emergencies with DKA being most common and HHS least common. Longer in-hospital stay and associated mortality are major issues with hyperglycaemic emergencies. Prevention plays an important role in reducing emergency room visits of such hyperglycaemic emergencies. The role of Government in empowering the health workers to identify these people at the earliest and follow up would be very effective. There is a paucity of review of literature in Indian studies, more studies will help covering demography of hyperglycaemic emergencies.

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