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Original research article

A clinical study of hyperglycemic emergencies in diabetic adults presenting to a rural tertiary care centre

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Abstract

Background: Diabetic Hyperglycemic Emergencies are major reasons for Intensive care unit admissions, with mortality rates of up to 30%.[1] The two most serious hyperglycemic emergencies are Diabetic Ketoacidosis and Hyperglycemic Hyperosmolar State. This study attempts to describe the clinical features, predictive factors, laboratory correlates and outcome (in terms of recovery with or without complications or death) of hyperglycemic emergencies in adults. Diabetic ketoacidosis and Hyperglycemic hyperosmolar state are the most serious acute metabolic complications of Diabetes mellitus that may be life threatening if not properly treated.

Objectives

To Study the

1. Clinical features of Hyperglycemic emergencies.
2. To identify factors predicting the outcome in terms of morbidity and mortality.

Methods

The following patients were included in the study:-

1. Diabetes mellitus type 1 and 2 presenting with Random blood sugar >=250 mg/dl, with either of the following-
   - Presence of ketone bodies in the blood or urine ketone bodies and metabolic acidosis (pH <7.30 or HCO3 <15 meq/L).
   - Dehydration and serum osmolality >300mOsm/kg.
2. Patients of age above 18 years.

All consecutive patients presenting to S.V.S Medical College & hospital emergency with above inclusion criteria fulfilled will be included in the study after taking informed written consent. Presenting complaints, examination findings, investigations will be noted and patients will be followed up from the time of admission till discharge/death.

Results: Incidence of Hyperglycemic emergencies among Diabetic patients was 8.22%. Diabetic Ketoacidosis (DKA) was 44% and Hyperglycemic hyperosmolar nonketotic state (HHS) was 56%. Majority of DKA patients cases were found in less than 30 years age group and HHS patients were common after 60 years of age. Among Hyperglycemic emergency patients studied 36% were women and 64% were men. Majority of women presented with DKA and majority of men presented with HHS. 30% had type 1 Diabetes Mellitus (DM) and 70% had type 2 DM. It was observed that DKA was more common among Type 1 DM and HHS was more common among Type 2 DM. Most common presenting clinical features were vomiting, Nausea, dehydration, altered sensorium, abdominal pain, tachycardia, vomiting, nausea, dehydration, altered sensorium, abdominal pain, tachycardia and acidotic breathing. All the symptoms were common among HHS patients except for acidotic breathing which was more common with DKA patients. Mean duration of diabetes was high among HHS patients (15years) than DKA group (8 years). Commonest precipitating factor was infection followed by discontinuation of treatment. Amongst infections, Pneumonia was the commonest in DKA patient's cases and Sepsis and Diabetic foot were the commonest among HHS patients.

Conclusion: Incidence of Diabetic Ketoacidosis (DKA) was 44% and Hyperglycemic hyperosmolar non ketotic state (HHS) was 56% during this period. Majority of DKA subjects were found in less than 30 years age group and HHS subjects were common after 60 years of age. Majority of women presented with DKA and majority of men presented with HHS. It was observed that DKA was more common among Type 1 DM and HHS was more common among Type 2 DM. All the symptoms were common among HHS patients except for acidotic breathing which was more common with DKA patients. Commonest precipitating factor was infection followed by discontinuation of treatment.

Keywords: Hyperglycemic emergencies, diabetic ketoacidosis, hyperglycemic hyperosmolar state

Introduction

The prevalence of diabetes is on the rise all over the world. Hyperglycemic Emergencies are, therefore, a

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key component in clinical practice. A high index of suspicion for diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic states (HHS), which are the two of the most serious acute complications of diabetes, is essential for timely intervention and also for prevention of recurrent episodes.
These Hyperglycemic Emergencies continue to be important causes of morbidity and mortality among patients with diabetes inspite of major advances in the understanding of their pathogenesis and more uniform agreement about their diagnosis and treatment. They can occur in both Type 1 and Type 2 Diabetes Mellitus. The annual incidence rate for Diabetic Ketoacidosis (DKA) estimated from population-based studies ranges from 4.6 to 8 episodes per 1,000 patients with diabetes [1, 2]. Currently, diabetic ketoacidosis (DKA) appears in 4-9% of all hospital admissions among patients with diabetes. The incidence of Hyperosmolar Hyperglycemic States (HHS) is difficult to determine because of the lack of population-based studies and the multiple combined illnesses often found in these patients. In general, it is estimated that the rate of hospital admissions due to Hyperosmolar Hyperglycemic State (HHS) is lower than the rate due to Diabetic Ketoacidosis (DKA) and accounts for <1% of all primary diabetic admissions [3, 4].
Mortality rates, which are <5% in Diabetic Ketoacidosis (DKA) and 15% in Hyperosmolar Hyperglycemic State (HHS), increase substantially with aging and the presence of concomitant life-threatening illness. The prognosis of both conditions is substantially worsened at the extremes of age and in the presence of coma and hypotension [5].

Materials and Methods
This study consists of 50 Patients of Diabetes mellitus with Hyperglycemic emergencies admitted to Department of General Medicine, S.V.S Medical College, Mahabubnagar between April 2022 to September 2023 were studied.
The following patients were included in the study:-

1. Diabetes mellitus type 1 and 2 presenting with Random blood sugar >250 mg/dl with either of the following-
   - Presence of ketone bodies in the blood or urine ketone bodies and metabolic acidosis (pH <7.30 or HCO3 <15 meq/L).
   - Dehydration and serum osmolality >300mOsm/kg.
2. Patients of age above 18 years.

All consecutive patients presenting to S.V.S Medical College & hospital emergency with above inclusion criteria fulfilled will be included in this study after taking informed written consent. Presenting complaints, examination findings, investigations will be noted and patients will be followed up from the time of admission till discharge/death. The data was collected and recorded in the proforma.
Following investigations were carried out:
1. Hematological and biochemical investigations:
a) Hb%, WBC count total and differential.
b) Blood sugar estimation was done by folin Wu method.
c) Serum electrolytes by flame photometry.

Radiological investigation
X-ray chest: PA view to see lung pathology.
E.C.G.: To see evidence of ischaemic heart disease and K+ changes in serial ECG's Urine: For routine and microscopy.
Urine culture and sensitivity Urine Sugar:
Benedict's Qualitative Test:
If the original blue colour of reagent changes to green/yellow-orange/brick red.

Urine Albumin
By heat and acetic acid test; results are interpreted as 1 + to 4+.

Urine for Ketone Bodies
Rothera's Test for acetone and acetoacetic acid:

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Results

Table 1: Age distribution of Subjects with Hyperglycemic emergency in Diabetes

		Emergency				Total
		DKA		HHS		
		No.	Row %	No.	Row %	
Age	<30 yrs	7	87.5%	1	12.5%	8
	31 to 40 yrs	5	71.4%	2	28.6%	7
	41 to 50 yrs	3	60.0%	2	40.0%	5
	51 to 60 yrs	5	38.5%	8	61.5%	13
	>60 yrs	2	11.8%	15	88.2%	17
Total		22	44.0%	28	56.0%	50

In the study total of 50 subjects of diabetes with hyperglycemic emergencies were included. Of which 22 (44%) subjects had Diabetic Ketoacidosis (DKA) and 28 (56%) patients had HHS (Hyperglycemic Hyperosmolar Non Ketotic state).
Among <30 yrs age group 7 (87.5%) had DKA and 1 (12.5%) had HHS Similarly in 31 to 40 yrs age group 5 (71.4%) had DKA and 2 (28.6%) had HHS.
Among 41 to 50 yrs age group DKA was seen in 3 (60%) and 2 (40%) had HHS. Where as after 50 yrs HHS was common than DKA i.e. in the age group 51 to 60 yrs 8 (61.5%) had HHS and 5 (38.5%) had DKA and in the age group >60 yrs 15 (88.2%) had HHS and DKA in 2 (11.8%). Hence in younger age group DKA was common and after 50 yrs HHS was common. This observation was statistically significant.

Table 2: Sex distribution of Subjects with Hyperglycemic emergency in Diabetes

		Emergency				Total
		DKA		HHS		
		No	Row %	No	Row %	
Gender	Female	12	66.7%	6	33.3%	18
	Male	10	31.2%	22	68.8%	32
Total		22	44.0%	28	56.0%	50

In the study 18(36%) were females and 32 (64%) were males. Among 18 females 12 (66.7%) had DKA and 6 (33.3%) had HHS. Among 32 males 22 (68.8%) had HHS and 10 (31.2%) had DKA. Hence it can be said that DKA was common among females and HHS in males. This observation was statistically significant.

Table 3: Type of diabetes among subjects with Hyperglycemic emergency in Diabetes

		Emergency				Total
		DKA		HHS		
		No	%	No	%	
Type of DM	1	12	80.0%	3	20.0%	15
	2	10	28.6%	25	71.4%	35
Total		22	44.0%	28	56.0%	50

It was observed that among 50 patients, 30% had Type 1 DM and 70% had Type 2 DM. Among 15 type 1 DM subjects 12 (80%) had DKA and 3 (20%) had HHS. Among 35 Type 2 DM subjects 71.4% had HHS and 28.6% had DKA. From this it can be said that DKA is common in Type 1 DM and HHS in Type 2 DM. This association was statistically significant.

Table 4: Clinical features among subjects with Hyperglycemic emergency in Diabetes

	Emergency				Total		p value
	DKA (n=22)		HHS (n=28)				
	No	%	No	%	No	%	
Vomiting	9	34.6%	17	65.4%	26	52%	0.164
Nausea	5	35.7%	9	64.3%	14	28%	0.462
Dehydration	1	33.3%	2	66.7%	3	6.0%	0.701
Altered sensorium	3	42.9%	4	57.1%	7	14.0%	0.948
Abdominal Pain	2	28.6%	5	71.4%	7	14.0%	0.375
Tachycardia	1	25.0%	3	75.0%	4	8.0%	0.425
Acidotic breathing	8	88.9%	1	11.1%	9	18.0%	0.003**

It was observed that out of 50 subjects, 26 (52%) had vomiting, 14 (28%) had Nausea, 3 (6%) had

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dehydration, 7 (14%) had altered sensorium and abdominal pain, 4 (8%) had Tachycardia and 9 (18%) had Acidotic breathing.

Among those who had vomiting 17 (65.4%) had HHS and 9 (34.6%) had DKA.

Among those who had Nausea 9 (64.3%) had HHS and 5 (35.7%) had DKA. Similarly majority of the features were common among HHS subjects except

Acidotic breathing which was seen in 8 out of 9 (88.9%) subjects. This observation of acidotic breathing being high among DKA subjects was statistically significant.

Table 5: Factors associated with Hyperglycemic emergency in Diabetes

	DKA (n=22)		HHS (n=28)		p value
	Mean	SD	Mean	SD	
Age (Yrs)	41.95	15.77	62.93	14.45	<0.001**
Duration of diabetes(yrs)	8.86	4.87	15.18	6.09	<0.001**
RBS at admission (mg/dl)	454.45	61.75	600	0.00	<0.001**
HbA1c %	11.47	1.21	12.21	1.14	.032
Blood urea(mg/dl)	37.86	12.9	41.82	13.42	.299
Serum Creatinine(mg/dl)	0.773	0.23	0.843	0.28	.361
Na+(meq/l)	131.64	7.65	133.89	11.97	.446
K+(meq/l)	3.823	1.25	3.99	1.19	.627
PH	7.13	0.03	7.39	0.06	<0.001**
Serum osmolality (mosm/kg)	312.68	3.65	347.46	5.18	<0.001**
Insulin Requirement (units)	58.18	12.05	103.54	21.19	<0.001**

In the study significant association was observed in age, Duration of diabetes, RBS at admission, PH, Serum Osmolality and Insulin requirement.

Mean age for DKA was less when compared to HHS. DKA was common in Younger individuals and HHS was seen among elderly individuals.

Mean duration of diabetes was high among HHS than DKA group. I.e. more the duration of diabetes more the risk for HHS, since type 1 DM is common among younger individuals mean duration of diabetes among DKA was lower than HHS group.

RBS average value in DKA group was 454 mg/dl and in HHS group was 600 mg/dl. This difference was statistically significant. I.e. in HHS group RBS will be more than DKA patients.

Mean PH was lower among DKA subjects than HHS group because of acidosis. This difference was statistically significant.

Mean Serum osmolality was lower among DKA subjects than HHS. This difference was statistically significant.

Mean Insulin requirement was less in DKA subjects than HHS group. This difference was statistically significant.

Table 6: Infectious Precipitating Factors associated with Hyperglycemic emergency in Diabetes

Precipitating factors	Emergency				Total	
	DKA		HHS			
	No	%	No	%	No	Column%
Diabetic foot	7	46.7%	8	53.3%	15	30.0%
Perianal abscess	0	-	1	100.0%	1	2.0%
Pneumonia	9	56.2%	7	43.8%	16	32.0%
Sepsis	2	20.0%	8	80.0%	10	20.0%
Urinary tract infection	4	50.0%	4	50.0%	8	16.0%
Total	22	44.0%	28	56.0%	50	100%

In the study among 50 subjects 15 (30%) had Diabetic Foot, 1 (2%) had.

Perianal abscess, 16(32%) had Pneumonia, 10 (20%) had Sepsis and 8 (16%) had UTI. Among 15 Diabetic foot subjects 7 (46.7%) had DKA and 8 (53.3%) had Diabetic Foot.

1 patient who had Perianal abscess had HHS, Out of 16 Pneumonia subjects 9 (56.2%) had DKA and 16 (43.8%) had HHS.

Out of 10 subjects who had sepsis 8 (80%) had HHS and 2 (20%) had DKA. UTI was there in 4 (50%) of DKA and HHS subjects respectively. There was no significant association between Infectious Precipitating factors and Hyperglycemic emergencies.

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Table 7: Compliance of treatment among subjects with Hyperglycemic emergency in Diabetes

Drug compliance	Emergency				Total	
	DKA		HHS			
	No	%	No	%	No	%
Both OHA and Insulin discontinued	2	15.4%	11	84.6%	13	26.0%
Insulin discontinued	13	59.1%	9	40.9%	22	44.0%
OHA discontinued	6	54.5%	5	45.5%	11	22.0%
No discontinuation of treatment	1	25.0%	3	75.0%	4	8.0%
Total	22	44.0%	28	56.0%	50	100.0%

In the study among 50 subjects 13 (26%) had Poor compliance for Both Insulin and Oral hypoglycemic agents, 22 (44%) had poor compliance for only insulin and 11 (22%) had poor compliance for only Oral hypoglycemic agents. 4 (8%) had good compliance to treatment.
Among 13 subjects with poor compliance for both insulin and OHA, 2 (15.4%) had DKA and 11 (84.6%) had HHS.
Among 22 subjects with poor compliance for Insulin majority i.e. 13 (59.1%) had DKA and 9 (40.9%) had HHS.
Similarly among 11 subjects with poor compliance for OHA, 6 (54.5%) had DKA and 5 (45.5%) had HHS.
There was no significant association between treatment compliance and type of Hyperglycemic emergency.

Table 8: Association between HTN and Hyperglycemic emergency in Diabetes

		Emergency				Total	
		DKA		HHS			
		No	%	No	%	No	%
Hypertension	No	15	65.2%	8	34.8%	23	46.0%
	Yes	7	25.9%	20	74.1%	27	54.0%
Total		22	44.0%	28	56.0%	50	100%

In the study among 50 subjects, 27 (54%) had hypertension and 23 (46%) were normotensive patients.
Among 27 Hypertensive subjects, 20 (74.1%) had HHS and 7 (25.9%) had DKA. This observation was statistically significant. I.e. HHS was commonly associated with Hypertension.

Table 9: Association of Complications among subjects with Hyperglycemic emergency in Diabetes

	Emergency				Total		p value
	DKA (n=22)		HHS (n=28)				
	No	%	No	%	No	%	
Retinopathy	9	40.9%	13	59.1%	22	44.0%	0.696
Nephropathy	4	40.0%	6	60.0%	10	20.0%	0.776
Neuropathy	2	50.0%	2	50.0%	4	8.0%	0.801
CAD	2	15.4%	11	84.6%	13	26.0%	0.016**
CVA	1	25.0%	3	75.0%	4	8.0%	0.425

In the study among 50 subjects, 22 (44%) had Retinopathy, 10 (20%) had Nephropathy, 4 (8%) had Neuropathy, 13 (26%) had CAD and 4 (8%) had CVA.

Among 22 subjects, 9 (40.9%) had DKA and 13 (59.1%) had HHS. Out of 10 subjects of Nephropathy 4 (40%) had DKA and 6 (60%) had HHS. Out of 4 Neuropathy subjects 2 (50%) of them had DKA and HHS respectively. Among 13 CAD subjects 11 (84.6%) had HHS and 2 (15.4%) had DKA. Similarly out of 4 subjects of CVA 3 (75%) had HHS and 1 (25%) had DKA. CAD is more common among patients with HHS than DKA.
Statistical significance was found only for CAD in hyperglycemic emergencies. I.e. CAD was more commonly associated with HHS than DKA.

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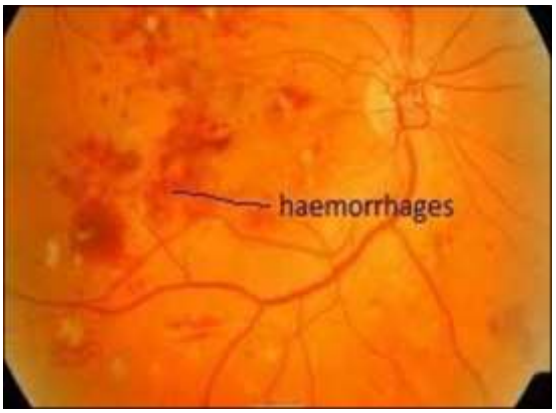

Fig 1: Nonproliferative Diabetic retinopathy

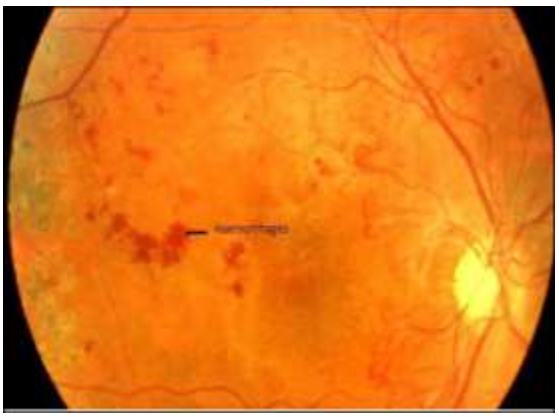

Fig 2: Non proliferative diabetic retionopathy

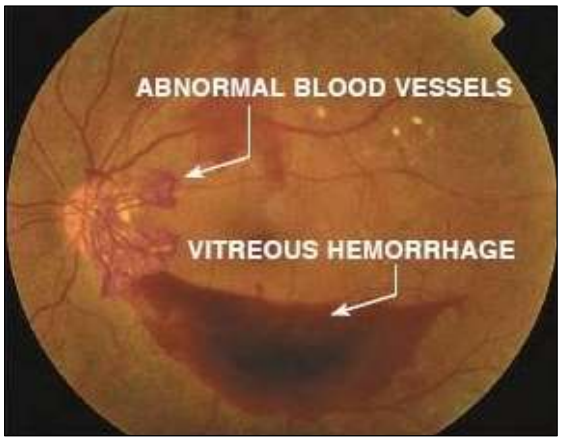

Fig 3: Proliferative Diabetic retinopathy

From the fig it can observed that complications were commonly seen in HHS group than DKA group.

Table 10: Association between Sodium and Hypeglycemic emergencies

		Emergency				Total	
		DKA		HHS			
		No.	%	No.	%	No.	%
Na	>145(meq/l)	1	14.3	6	85.7	7	14
	135 to 145 (meq/l)	4	57.1	3	42.9	7	14
	<135 (meq/l)	17	47.2	19	52.8	36	72
Total		22	44.0%	28	56.0%	50	100%

It was observed that out of 50 subjects, 7 (14%) had hypernatremia, 7 subjects (14%) had normal sodium levels and 36 (72%) had Hyponatremia.

Out of 7 Hypernatremia subjects, 6 (85.7%) had HHS and 1 patient (14.3%) had DKA, similarly in 7 subjects with normal sodium levels, 4 (57.1%) had DKA and 3 (42.9%) had HHS. Out of 36 Hyponatremia subjects 19 (52.8%) had HHS and 17 (47.2%) had DKA. There was no significant association between Na levels and type of emergency.

Table 11: Association between Serum osmolality and Hyperglycemic emergencies

		Emergency				Total	
		DKA		HHS			
		N(22)	%	N(28)	%	n	%
Serum osmolality	<320 (mosm/kg)	22	100%	0	0	22	44.0%
	321 to 340	0	0	2	7.1%	2	4.0%
	>340	0	0	26	92.9%	26	52.0%
Total		22	44%	28	56%	50	

It was observed that out of 50 subjects, 22 (44%) subjects had DKA with Serum osmolality <320 msom/kg and remaining 28(66%) had HHS with Serum Osmolality of 321 to 340 mosm/kg in 2 (4%) subjects and 26(52%) subjects with serum osmolality >340 mosm/kg.

Out of 28 HHS subjects 2(7.1%) had Serum Osmolality of 321 -340 and 26 (92.9%) had Serum

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Osmolality >340mosm/kg. There was significant association between Serum osmolality and type of emergency

Table 12: Outcome among subjects with Hyperglycemic emergency in Diabetes

		Emergency				Total	
		DKA		HHS			
		No	%	No	%	No	%
Outcome	Survived	21	44.7%	26	55.3%	47	94.0%
	Mortality	1	33.3%	2	66.7%	3	6.0%
Total		22	44%	28	56%	50	100

In the study out of 50 subjects who presented with Hyperglycemic emergencies 47 (94%) recovered during treatment and only 3 subjects (6%) had mortality.
Among 47 subjects who recovered, 21 (44.7%) were DKA subjects and 26 (55.3%) were HHS subjects. Out of 3 subjects who succumbed death 1 (33.3%) had DKA and 2 (66.7%) had HHS. There was no significant difference on mortality with respect to DKA and HHS. I.e. in both emergencies subjects recovered after treatment.

Table 13: Association between Compliance of treatment and Outcome among subjects with Hyperglycemic emergency in Diabetes

Compliance of treatment	DKA outcome				HHS outcome			
	Death (n=1)		Survived (n=21)		Death (n=2)		Survived (n=26)	
	n	%	n	%	n	%	n	%
Both Insulin and OHA discontinued	1	50.0%	1	50.0%	0	0	11	100.0%
Insulin discontinued	0	0	13	100.0%	1	11.1%	8	88.9%
OHA discontinued	0	0	6	100.0%	1	20.0%	4	80.0%
No discontinuation of treatment	0	0	1	100.0%	0	0	3	100.0%
Total	1	4.5%	21	95.5%	2	7.1%	26	92.9%
p value	0.015**					0.469		

Out of 22 DKA subjects, 2 subjects had poor compliance for both Insulin and Oral hypoglycemic drugs. Among these two, one patient (50%) survived and one patient (50%) succumbed death.
No mortality occurred in subjects with history of only insulin discontinuation and only OHA discontinuation. This observation among DKA subjects was statistically significant.
Out of 28 HHS subjects, 9 had poor compliance for Insulin and 5 had poor compliance for OHA. Out of 9 subjects with poor compliance for Insulin 8 subjects (88.9%) survived and only 1 patient (11.1%) succumbed death. Similarly out of 5 subjects with poor compliance for OHA, 4 subjects (80%) recovered and only 1 patient (20%) succumbed death. There was no significant association between outcome and Drug compliance in HHS group.

Table 14: Association between Complications and Mortality among subjects with Hyperglycemic emergency in Diabetes

	Complications	Death (n =3)
DKA	CVA + Nephropathy	1
HHS	CAD + Retinopathy	2

Among 22 subjects of DKA, there was one had mortality and 21 survived. One patient who succumbed death had CVA plus nephropathy as complication. In 28 HHS subjects there was 2 patients who had mortality and 26 survived. Two subjects who succumbed death had CAD plus retinopathy as complication.

Discussion

Incidence

In our hospital the total number of admission in the year 2023 was 3010 in medical wards. Out of that there were 608 diabetics, constituting 20.12% of the total admissions. Out of 608 Diabetics, 50 patients who developed Hyperglycemic Emergencies were included in this study. Out of which 32 were males and 18 were female patients.
Incidence of Hyperglycemic emergencies in our study was 8.22%. Diabetic Ketoacidosis (DKA) was 44% and Hyperglycemic hyperosmolar non ketotic state (HHS) was 56%.
A study by Chung *et al.* [6] showed incidence of DKA is 4.6 to 8.0 per 1000 person-years, whereas that of HHS is less than 1 per 1000 person-years.
A study by Ogbera *et al.* [7] showed that Hyperglycaemic emergencies (HE) account for 40% of all DM related hospitalization with a preponderance of DKA admissions compared to that of HHS.

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In contrast to these studies, this study showed higher incidence of HHS, because more of Type 2 DM subjects were included in this study.

Age

In this study the minimum age was 24 years and the maximum age was 88 years. The mean age was 54 years. It was observed that majority of DKA cases 87.5% were found in less than 30 years age group and HHS was common after 60 yrs of age (88.2%). This was observed because Type 1 DM patients were more in DKA and Type 2 DMpatients more in HHS.

Sex

In the study 18 (36%) were females and 32 (64%) were males. It was observed that Majority of females presented with DKA 12 (66.7%) and majority of males presented with HHS 22 (68.8%).
Louis Vignati *et al.* [8] has shown a higher incidence of HEs in women compared to men with DKA more in females and HHS more in males.
The above study correlates with this study.

Duration of diabetes

Mean duration of diabetes was high among HHS (15years) than DKA group (8 years). I.e. more the duration of diabetes risk for HHS is high. Type 1 DM is common among younger individuals mean duration of diabetes among DKA was lower than HHS group.
In a study by Patel JC *et al.* [9] reported, the duration of diabetes varied in the following manner: Up to 1 year incidence of HEs was 2.2%, 1-5 years 2.8%, 6-10 yrs 2.9% and >10 yrs 4.3%.

Precipitating factors

In the present study, the commonest precipitating factor was infection followed by discontinuation of treatment.
Amongst infections, Pneumonia was the commonest in DKA cases (40.9%) and Sepsis and Diabetic foot was the commonest among HHS cases (28.5%). Infection was high due to decreased immunity and comorbid conditions. Documented reasons for poor drug compliance may be due to poor accessibility to health facilities, high costs of drugs often resulting from polypharmacy because of co-morbidities and also ignorance on self-care habits of DM [81, 82]. In various studies infection was main precipitating factor followed by poor drug compliance. In a study by Ogbera *et al.* [10] poor drug compliance was a major precipitant. This study correlates with the above studies.

Clinical profile

In this study 52% had vomiting, 28% had Nausea, 6% had dehydration, 14% had altered sensorium, 14% had abdominal pain, 8% had tachycardia and 18% had acidotic breathing.
It was observed that all the symptoms were common among HHS patients except for acidotic breathing which was common with DKA patients (88.9%).
In a study by Jean Louis Chaisson *et al.* [11] the clinical features of DKA were:- nausea (83.4%), vomiting (78.5%) and abdominal pain (51%).

Biochemical profile

Mean RBS in DKA group was 454 mg/dl and HHS group was 600 mg/dl. pH mean for DKA was 7.13 ± 0.03 and mean for HHS was 7.39±0.06 K value mean for DKA was 3.823 ± 1.25 meq/l and mean for HHS was 3.99±1.19 meq/l.
Na value mean for DKA was 131.64 ±7.65 meq/l and mean for HHS was 133.89±11.97 meq/l.
Urea value mean for DKA was 37.86 ±12.9 mg/dl and mean for HHS was 41.82±13.42mg/dl. Mean PH was lower among DKA patients than HHS group because of acidosis. Mean Serum Osmolality among DKA patients was lower than in HHS patients.
Pinto ME *et al.* [12] study reported Biochemical abnormalities occurred more in people with DKA except for hypernatraemia (HN) and hypokalaemia (HP) which occurred in higher percentages of subjects with HHS viz. (12%, 47% in HHS vs. 2%, 35% in DKA). Hypokalemia was the prevalent form of electrolyte imbalance.

Factors predicting the outcome in hyperglycemic emergencies

In this study Age and duration of DM were the predictors for Mortality in DKA patients and abnormal levels of Sodium (both hypo and hypernatremia), Potassium (both hypo and hyperkalemia) and Increased Serum Osmolality were the predicting factors for mortality in HHS patients. Other factors were not significantly predicting the outcome in hyperglycemic emergencies in DM.
A study by Stamatis P *et al.* [13] on mortality prediction model in diabetic ketoacidosis reported the following as the predictors of mortality. These were severe co-existing diseases, Age, Duration of DM, pH <7.0 at presentation, units of insulin required in first 12 hrs >50 and serum glucose >300mg/dl after

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12 hrs, depressed mental state and fever after 24 hrs.

Conclusion

Incidence of Hyperglycemic emergencies among Diabetic patients was 8.22%. Diabetic Ketoacidosis (DKA) was 44% and Hyperglycemic hyperosmolar nonketotic state (HHS) was 56%. Majority of DKA cases were found in less than 30 yrs age group and HHS were common after 60 years of age. Among Hyperglycemic emergency patients studied 36% were women and 64% were men. Majority of women presented with DKA and majority of men presented with HHS. 30% had type 1 DM and 70% had type 2 DM. It was observed that DKA (was more common among Type 1 DM and HHS was common among Type 2 DM. Most common presenting clinical features were vomiting, Nausea, dehydration, altered sensorium, abdominal pain, tachycardia and acidotic breathing. All the symptoms were common among HHS patients except for acidotic breathing which was common with DKA patients. Mean duration of diabetes was high among HHS (15years) than DKA group (8 years).

Commonest precipitating factor was infection followed by discontinuation of treatment. Amongst infections, Pneumonia was the commonest in DKA cases and Sepsis and Diabetic foot was the commonest among HHS patients. The biochemical parameters noted in this study were those of hypokalaemia. hyponatraemia, hypernatraemia and azotaemia and hyperkalaemia. These abnormalities occurred more in people with HHS. Hyponatremia was the prevalent form of electrolyte abnormality in hyperglycaemic emergencies.

Mean Serum Osmolality among DKA patients was lower than in HHS patients. Some of the clinical and biochemical parameters which indicate bad prognosis were age, duration of diabetes, RBS at admission, PH, Insulin requirement and comorbid conditions. Age and duration were the predictors for Mortality in DKA patients and abnormal levels of Sodium (both hypo and hypernatremia), Potassium (both hypo and hyperkalemia) and Increased Serum Osmolality levels were the predicting factors for mortality in HHS patients.

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