A prospective observational study on clinical profile, precipitating factors and management in patients presenting with diabetic ketoacidosis in a tertiary care hospital

[1]Mahesh P, [2]Balakeshwa Ramaiah, [3]Shibi Mary Thomas
[1]Clinical Pharmacist, [2]HOD-Pharmacy Practice, [3]Associate Professor
Department of Pharmacy Practice
Karnataka College of Pharmacy
Bengaluru, India.

Abstract

Aim
To assess clinical profile, precipitating factor and management in patient presenting with Diabetic ketoacidosis in a tertiary care hospital. In addition to that to know the effect of socioeconomic status, challenges encountered in management and finally to comapre the biochemical profile before and after treatment in the DKA patients.
Methodology
In this Prospective Observational study, a sample size of 40 patients with DKA and metting the inclusion criteria were considered for the study. Diagnosis of diabetic ketoacidosis was made according to the Blood glucose level more than 250mg/dl ,pH<7.3 ,Presence of blood ketone(≥0.6mmol/L) and Patients of age >15 admitted to adult ICU or General Medicine.
Results
Out of 40 patients admitted for diabetic ketoacidosis; 38 had type 2diabetes(95%) and 2(5%)were type 1 diabetes. the age of the patients ranged between 25 to 91 years with the mean age of 58.38±18.45 years.the gender distribution was 25(63%)males and 15(37%) female.16(40%) patients were in the lower middle class and 12(30%)patients were in upper middle class in socioeconomic classification.The most common clinical features at the time of presentation were Nausea /vomiting (63.33%), Pain abdomen(43%),dehydration(33.33%) and altered sensorium (30%).The commenest precipitating factor was infection in 21(52.5%)patients, Non compliance in 12(30%) followed by pancreatitis in 6(15%)patients. based on the severity of DKA 21(52.5%) patient had mild and 11(27.5%)patients had moderate DKA.majority of the patients ie 16(40%) required more than 100units of insulin to clear blood ketone .11(27.5%)patient required more than 72 hrs of insulin therapy for clearance of blood ketone.the complication developed in DKA management were 15(37.5%)patient showed hopokalemia and 3(7.5%) patients showed hypoglycemia.
Conclusion
Early recognition of diabetic ketoacidosis (DKA) through symptoms like nausea, vomiting, and dehydration leads to better outcomes. Common triggers include respiratory and urinary tract infections, poor compliance, and pancreatitis. Most patients were from the lower-middle socioeconomic class. Insulin therapy requires close monitoring to avoid hypokalemia and hypoglycemia, with treatment showing significant improvement.

Introduction

Diabetes mellitus is not one disease, but rather is a heterogeneous group of multifactorial, polygenic syndromes characterized by an elevated fasting blood glucose caused by a relative or absolute deficiency in insulin. Most cases of Diabetes mellitus (DM) can be seperated into two groups, type I formerly called as insulin- dependent DM and type II formerly called as noninsulin-dependent DM.[1]

Diabetic ketoacidosis (DKA) is a severe acute event in diabetes mellitus characterized by dehydration, hyperglycaemia and metabolic acidosis due to ketone hyperproduction.[2] National Centre for health statistics showed that most patients with DKA were between the ages of 18 and 44 years (56%) and 45 and 65 years (24%), with only 18% of patients <20 years of age. DKA presents with vague symptoms such as nausea, vomiting, and abdominal pain. Other symptoms include increased thirst and urination. Kussmaul breathing (labored deep breathing) and fruity odor are specific signs present on examination of a patient with diabetic ketoacidosis .DKA consists of the triad of hyperglycaemia, ketosis, and acidemia. An arterial pH of less than 7.35, Serum Bicarbonate (HCO3-) value of less than 15 mEq/L, and a blood glucose level of greater than 250 mg/dl with a moderate degree of ketonaemia and/or ketonuria (as determined by nitroprusside method) are necessary for the diagnosis of DKA.[3,4]

Various precipitating factors of DKA were reported in studies, especially missed insulin dose and an ongoing infection. Other precipitating factors were stressful events such as stroke, myocardial infarction, and trauma, as well as substance abuse.[4] Younger age, underweight, being without a job, low personal and/or mother educational level, travel, home glucose monitoring less than 7 times a week, uncontrolled HbA1c and insulin stoppage were the cause of DKA regardless of the reasons to stop were associated with an increased risk of DKA.[5,6]

The four key points of DKA patient management are (i) admission in a high dependency unit if presence of at least one severity criterium, (ii) rehydration with isotonic saline, (iii) intravenous insulin therapy, and (iv) potassium supplementation. The main adverse unfavorable events were hypoglycemia and hypokalemia.[8] Management requires careful replacement of fluid and electrolyte deficits, intravenous administration of insulin, and close monitoring of clinical and biochemical parameters directed towards timely detection of complications, including hypokalemia, hypoglycemia and cerebral edema.[9] Treatment outcome was considered good for patients who have shown improvement at discharge, while poor for patients who left against medical advice or died in the hospital.[10] The prevalence of diabetic ketoacidosis among DM patients in a study was 40%.[7]

Objectives

Primary objective

- To assess clinical profile, precipitating factor, management in patient presenting with DKA.

Secondary objective

- To assess the effect of socioeconomic status on DKA.
- To assess the challenges encountered/ complication in management of DKA.
- To assess the drug induced DKA.
- To compare Biochemical profile before and after Treatment.

Methodology

Study type and site: This is a Prospective Observational study
Study Population: The study population includes patients who are diagnosed by DKA
Source of data and Materials:

- Emergency Department's Initial Assessment Record
- Initial Assessment form
- ICU monitoring chart
- Progress charts
- Medication Chart
- ABG Analysis chart
- Lab record investigation chart, MRD software
- Collection of Socioeconomic factor from the patient/bystanders by Kuppuswamy scale 2021
- Patient interaction

Inclusion criteria:
1. Patients with Type 1 and Type 2 Diabetes Mellitus diagnosed with DKA
2. Blood glucose level more than 250mg/dl
3. pH<7.3
4. Presence of blood ketone.
5. Patients of age >15 admitted to adult ICU or General Medicine

Exclusion Criteria:
1. Pregnancy and Lactating women
2. Patient with Respiratory acidosis
3. Patients with endocrine disorders like Cushing's syndrome, Acromegaly

Method of collection of data
The prospective observational studies will be done in the ICU and general medicines department. The patients who meet the criteria will be enrolled in the study. The step includes collection of demographic details like age , sex , patient presenting complaints, past history, precipitating factor and the medication regimen will be collected in the suitable data collection form . The patient or caregiver are interviewed for the precipitating factors and for the socioeconomic status of the family by Kuppuswamy scale 2021 for the corelation of precepitating factors in DKA. These are documented in the proper data collection form and followed till the patients are discharged from the hospital.

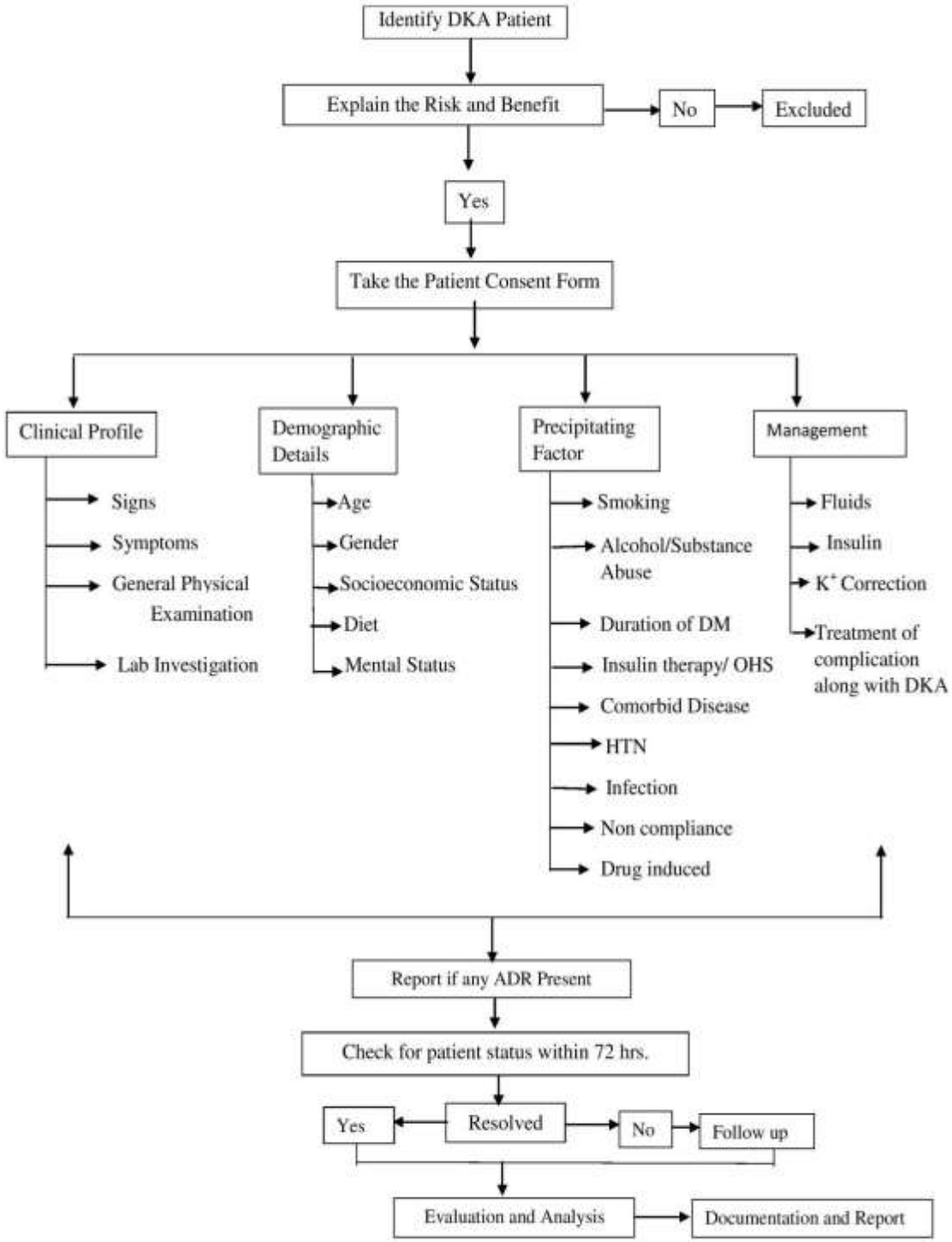
Study procedure :

- Collection of clinical profile
- Collect the precipitating factor from the patient/bystanders like missed dose, Drug induced(SGLT2 inhibitors), stroke, sepsis, MI or pancreatitis.
- Analysis of clinical parameters
  i. Blood glucose level
  ii. Blood gas

iii. *blood ketone*
iv. *pH*
v. HCO3—levels

- Management of DKA
- Analysis of complication during the management of DKA like hypoglucemia, hypokalemia, oliguria and creberal edema.
- Collection of Socioeconomic factor from the patient/bystanders by Kuppuswamy scale 2021
- Comparision of biochemical profile before and after treatment
- Analysis of the above data by simple statistics.

Study Design:



Results:

Table 1: Distribution Of Age In Study Patients

Age (years)	No. of Patients	Percentage
20-40	11	27.50
41-60	10	25.00
61-80	13	32.50
81-100	6	15.00
Total	**40**	**100.00**

mean 58.38±18.45 years 25 to 91

Graph 1: Distribution Of Age In Study Patients

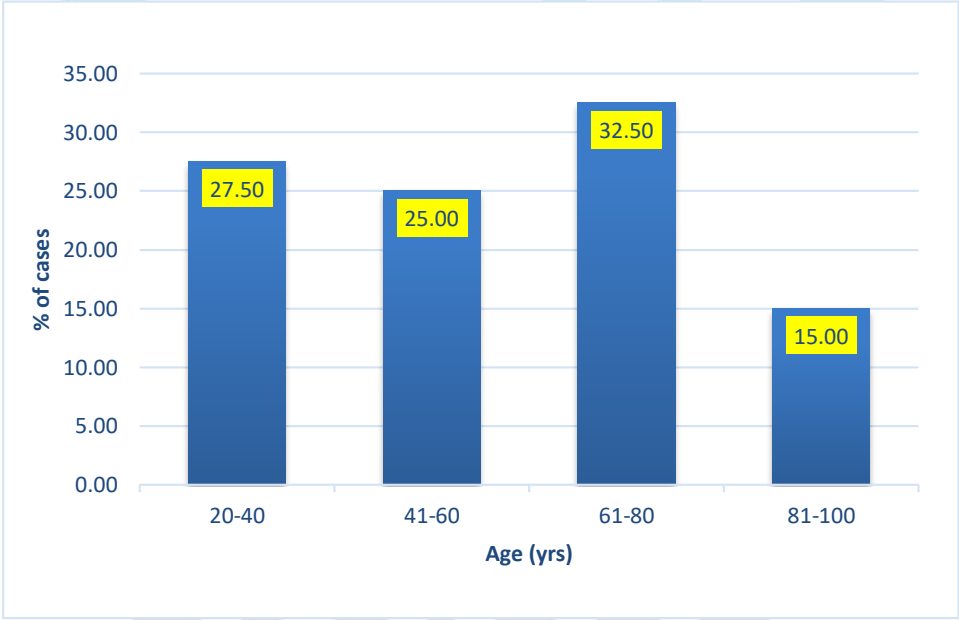


Table 2: Distribution Of Patients According To Gender

Gender	No.of Patients
Male	25 (63 %)
Female	15 (37%)
Total	**40 (100%)**

Graph 2: Distribution Of Patients According To Gender

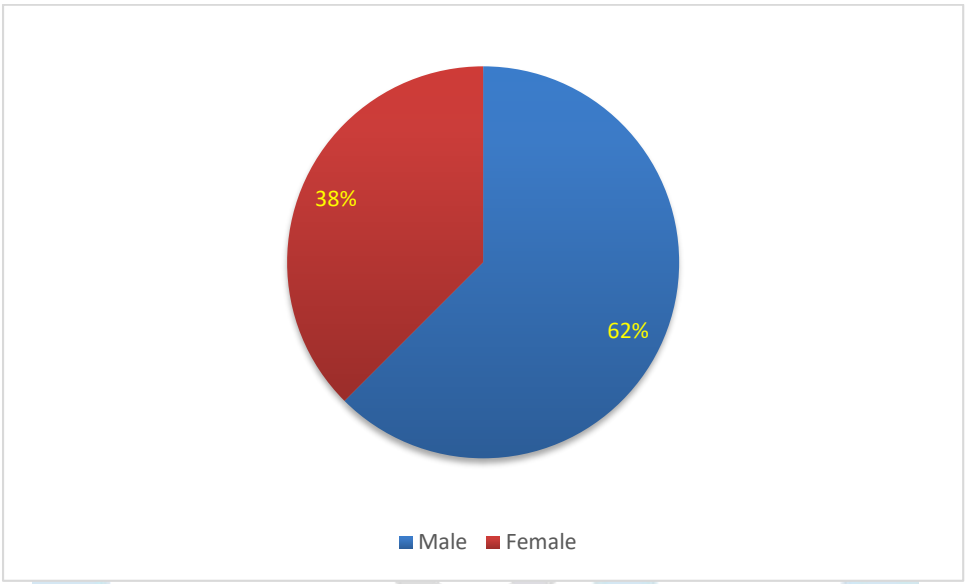


Table 3: Distribution Of Type 1 And Type 2 DM In Diabetic Ketoacidosis Patients

Total No. of patients (Percentage)	Type 1 (Percentage)	Type 2 (Percentage)
40 (100%)	2 (5%)	38 (95%)

Graph 3: Distribution Of Type 1 And Type 2 DM In Diabetic Ketoacidosis

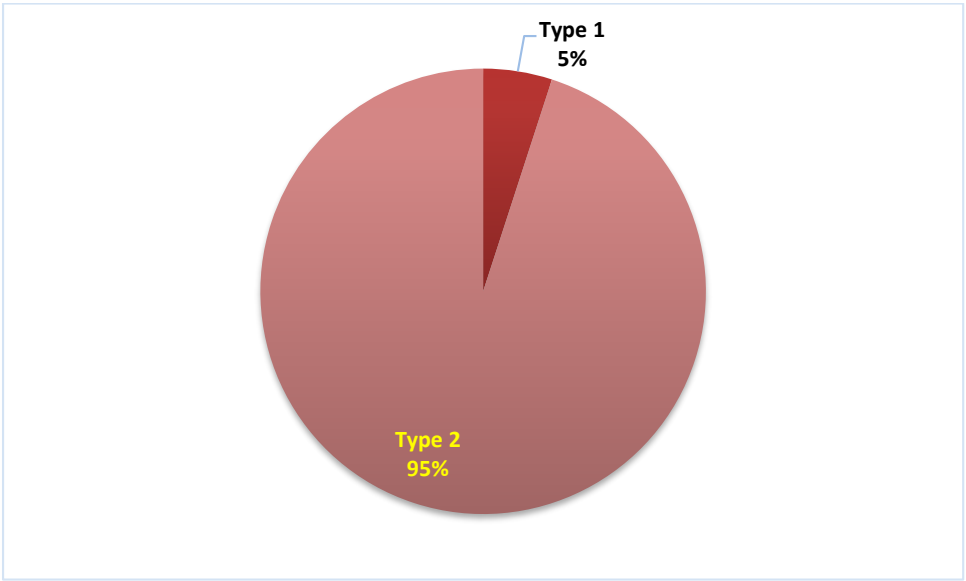


Table 4: Distribution Of Patients According To The Duration Of DM In Known Case Of DKA

Duration of diabetes (years)	No. Of Patients	Percentage
0-1	4	10
2-5	8	20
6-10	10	25
>10	18	45
Total	**40**	**100**

Mean duration ± SD 10.7 ± 6.8321, Range 1-25

Graph 4: Distribution Of Patients According To The Duration Of DM In Known Case Of DKA

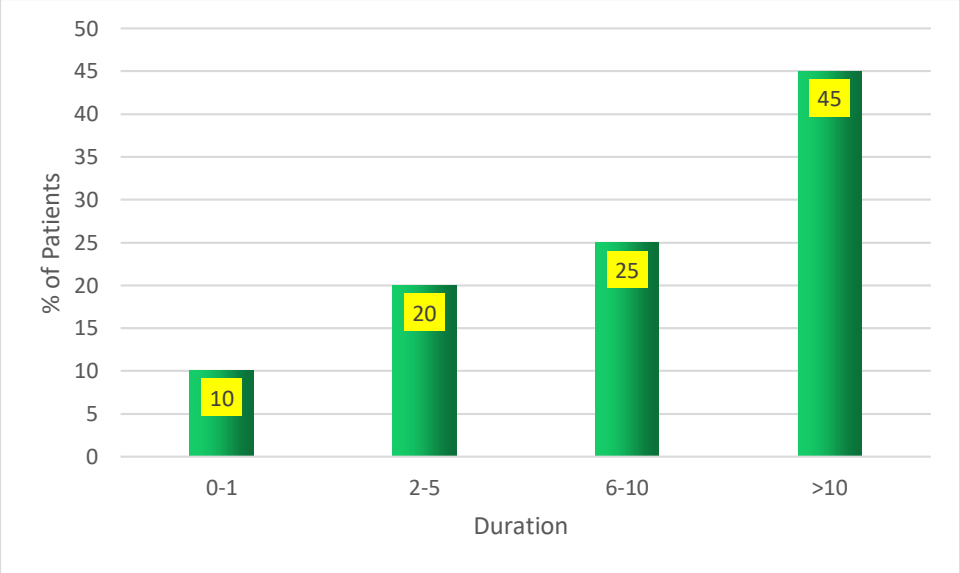


Table 5: Distribution of Patients according to HbA1c level

HbA1c level	No. Of patients	Percentage(%)
<7	1	2.5
7-10	13	32.5
11-13	14	35
14-16	7	17.5
>16	5	12.5
Total	**40**	**100**

Graph 5: Distribution Of Patients According To Hba1c Level

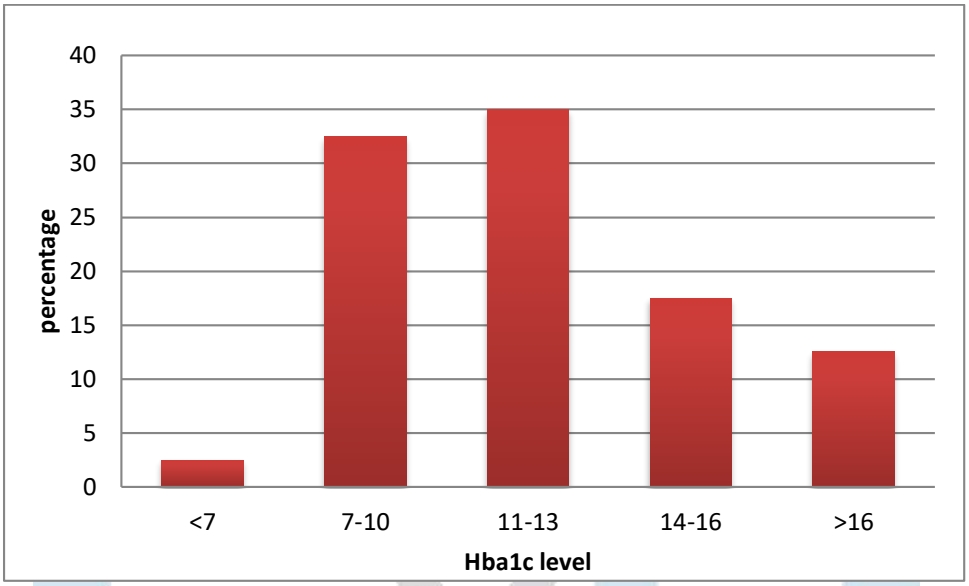


Table 6: Distribution Of Patients According To Socioeconomic Class

SOCIOECONOMIC CLASS	NO OF CASE	PERCENTAGE
Upper	2	5
Upper middle	12	30
Lower middle	16	40
Upper lower	9	22.5
Lower	1	2.5
Total	**40**	**100**

Graph 6: Distribution Of Patients According To Socioeconomic Class

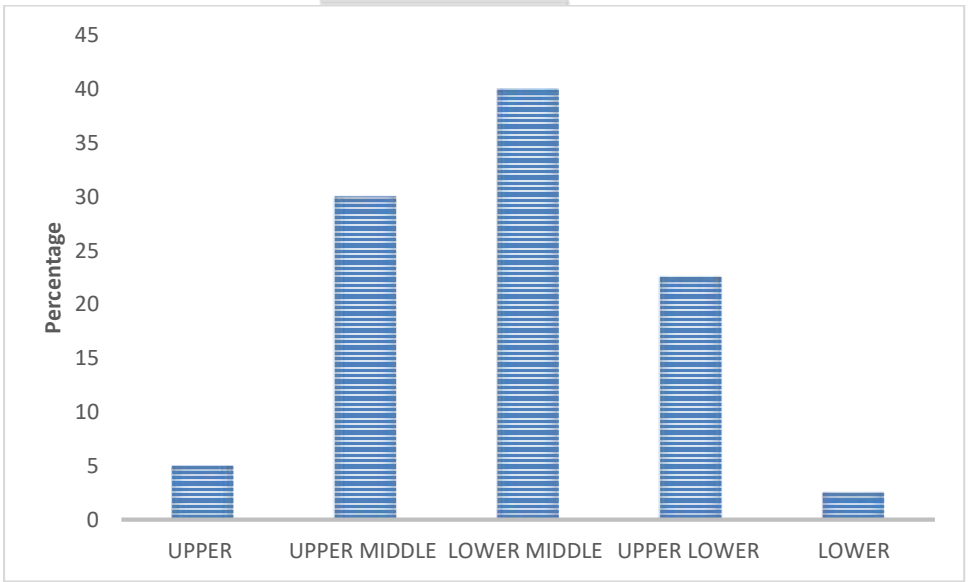


Table 7: Distribution Of Patient According To History Of Previous DKA

History of DKA	Yes	No
Previous H/o DKA	3	37

Graph 7: Distribution Of Patient According To History Of Previous DKA

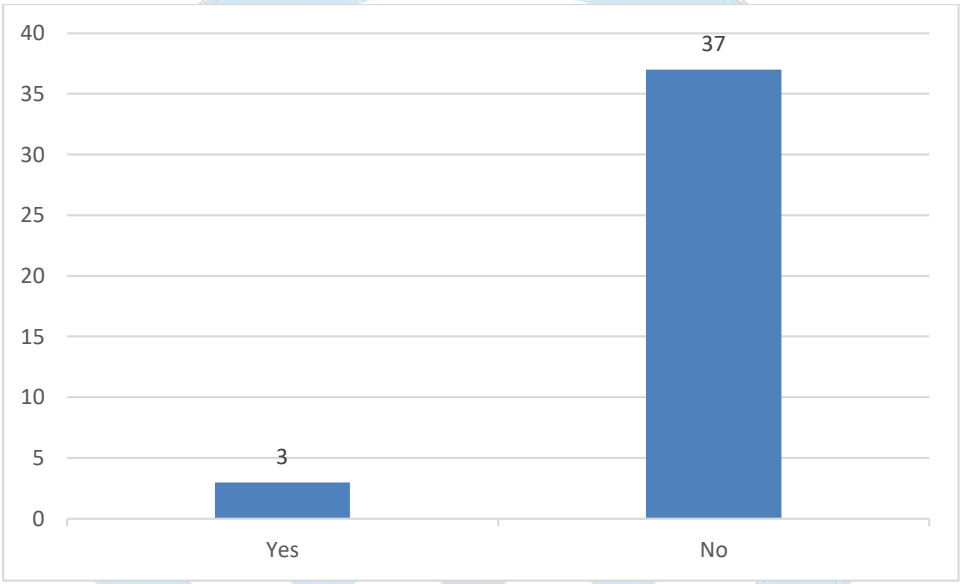


Table 8: Distribution Of Patients According To Treatment History Before Admission

Treatment	No of patients	Percentage
OHAs	17	42.5
Insulin	4	10
OHAs+ insulin	14	35
Nil	5	12.5
Total	40	100

Graph 8: Distribution Of Patients According To Treatment History Before Admission

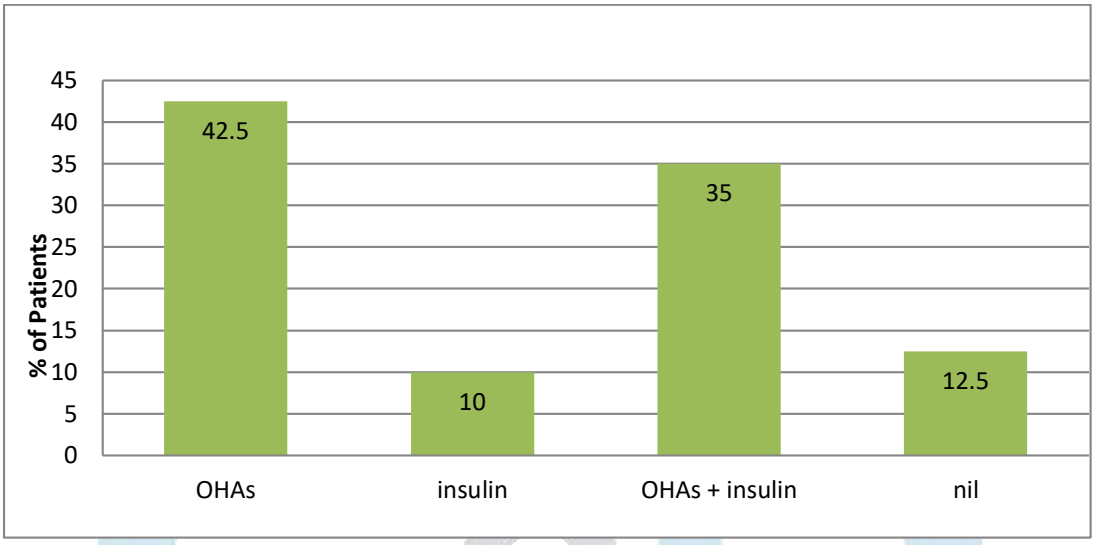


Table 9: Distribution Clinical Profile In DKA Patients

Symptoms /Signs	No of Patients Observed (N=40)	Percentage (%)
Nausea/vomiting	24	60
Fever	18	45
Abdominal pain	15	37.5
Dehydration	12	30
Tiredness	12	30
Loose stools	11	27.5
Hypotension	9	22.5
Shortness of breath	9	22.5
Altered sensorium	8	20
Cough	4	10
Kusmal breathing	4	10
Burning mircturation	3	7.5
Thrist/polyuria	2	5

Graph 9: Distribution Clinical Profile In DKA Patients

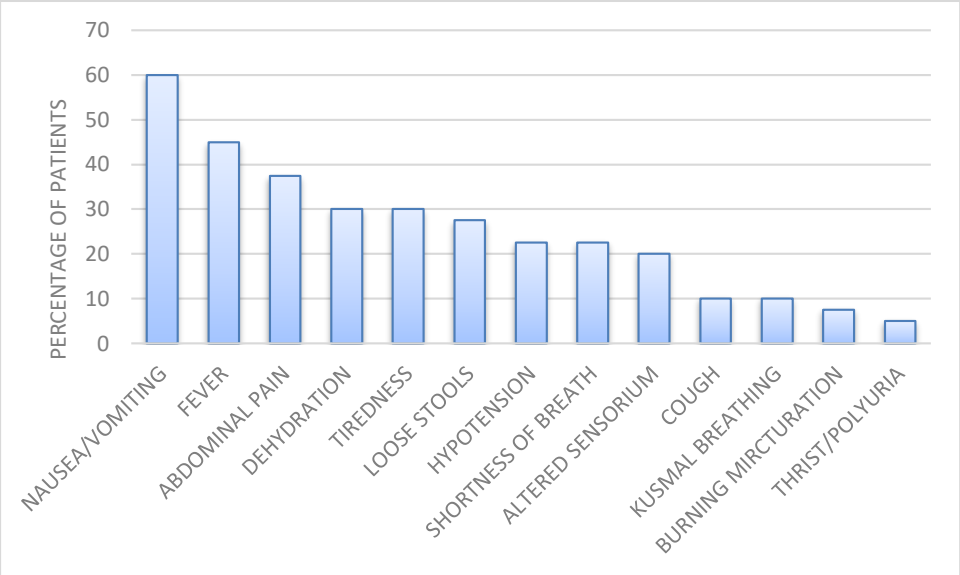


Table 10:Distribution Precipitating Factors In DKA Patients

Precipitating factors	No of patients (n=40)	Percentage
Infection	21	52.5
Pancreacitits	6	15
Non Compliance	12	30
First Presentation	2	5
Age	3	7.5
Substance Abuse	2	5

Table 10: Distribution Precipitating Factors In DKA Patients

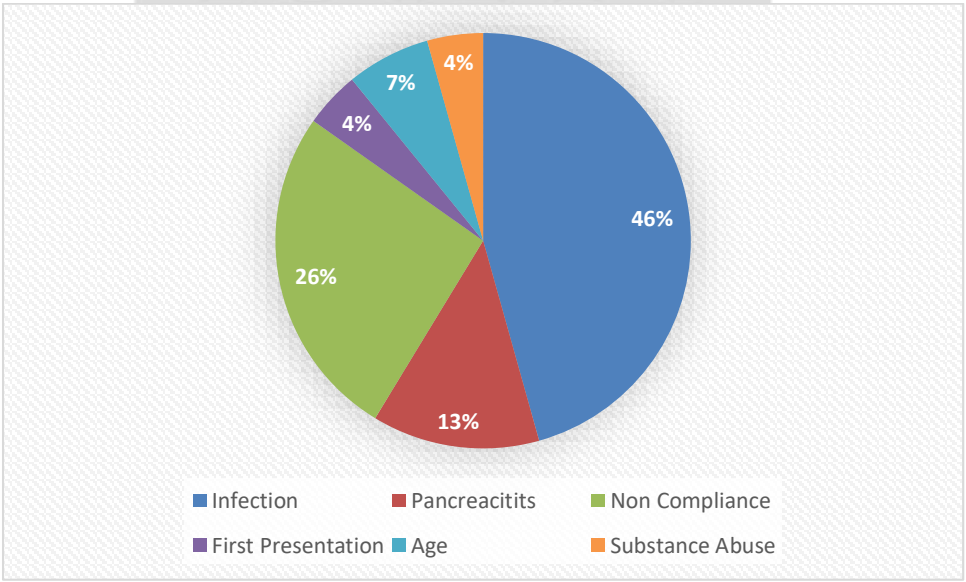


Table 11: Distribution Of Type Of Infection Occured In DKA Patients

Infection Identification	No of patients	Percentage
LRTI	7	33.3
UTI	5	23.8
Diabetic Foot	4	19.0
Urosepis	3	14.3
Pneumonia	2	9.5
TOTAL	**21**	**100**

Graph 11: Distribution Of Type Of Infection Occured In DKA Patients

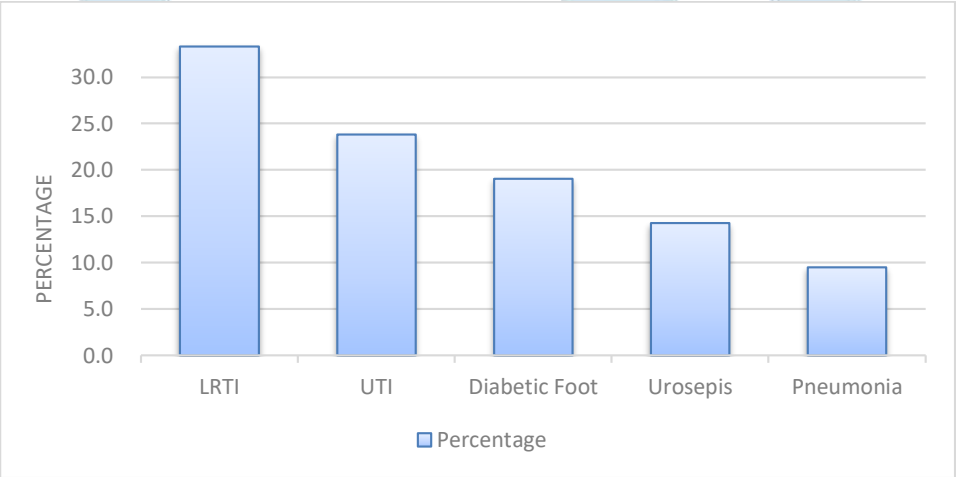


Table 12: Distribution Of Suspection Of Drug Induced DKA

Suspection of DKA by Drug	Identified	Not indentified
SGLT2 inhibitors	2 (5%)	38(95%)

Graph12: Distribution Of Suspection Of Drug Induced DKA

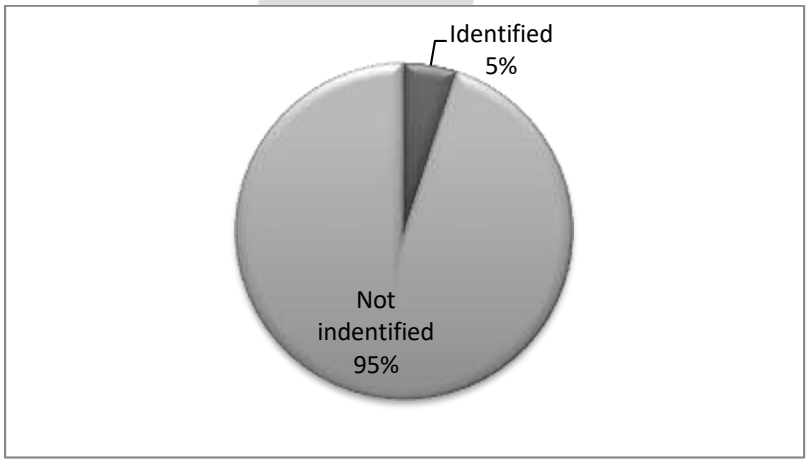


Table 13: Distribution Of Severity In Dka Patients

Severity of DKA	No of patients	Percentage(%)
Mild	21	52.5
Moderate	11	27.5
Severe	8	20
Total	**40**	**100**

Graph13: Distribution Of Severity In DKA Patients

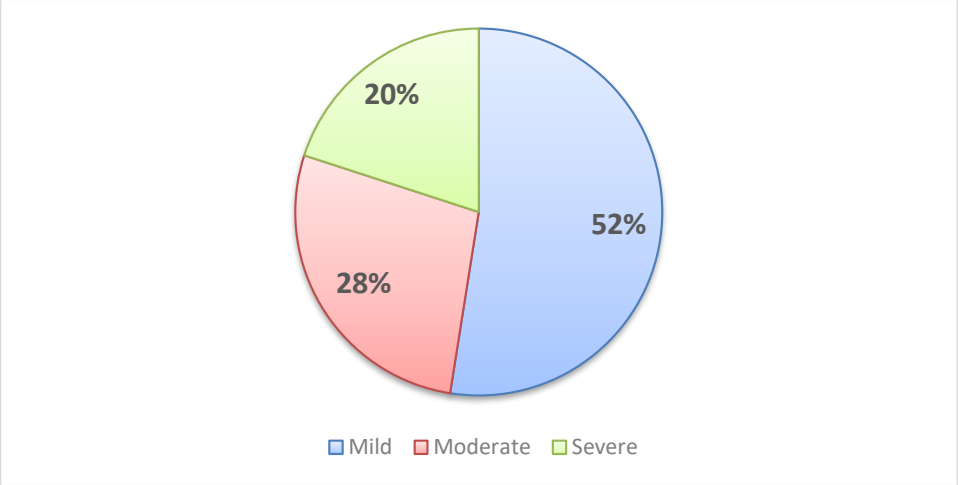


Table 14: Distribution Of Dose Of Insulin Required To Clear Blood Ketone (In Units)

Groups	Dose of Insulin required to clear blood ketone (in units)	No.of cases	Percentage(%)
I	0-25	5	12.5
II	26-50	7	17.5
III	51-75	5	12.5
IV	76-100	7	17.5
V	>100	16	40

Graph 14: Distribution Of Dose Of Insulin Required To Clear Blood Ketone (In Units)

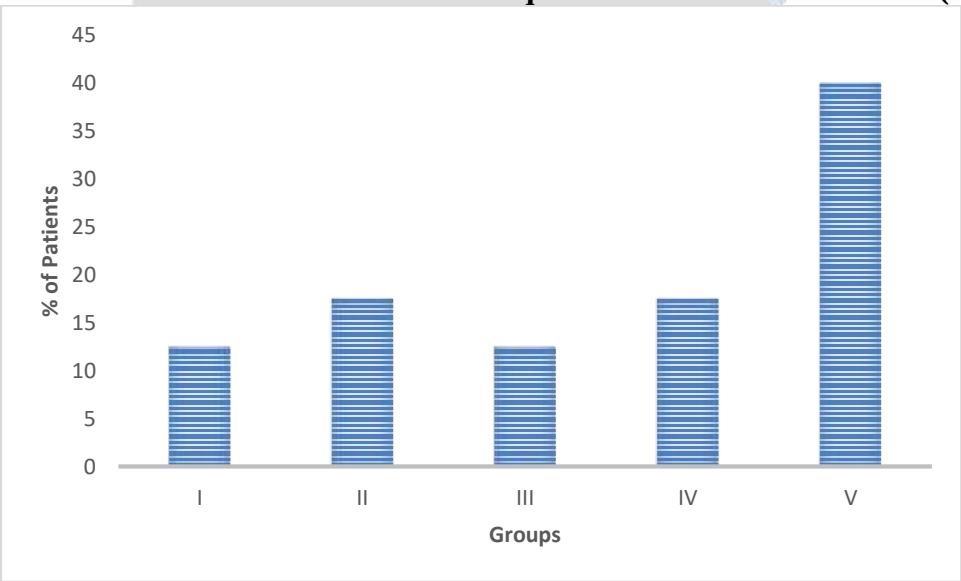


Table 15: Distribution Of Duration Of Insulin Therapy Required For Clearance Of Blood Ketone (In Hours)

Groups	Duration of insulin therapy required for clearance of blood ketone (in hours)	No of cases	Percentage
I	0-12	3	7.5
II	13-24	9	22.5
III	25-36	6	15
IV	37-48	3	7.5
V	49-72	8	20
VI	>72	11	27.5

Graph15: Distribution Of Duration Of Insulin Therapy Required For Clearance Of Blood Ketone (In Hours)

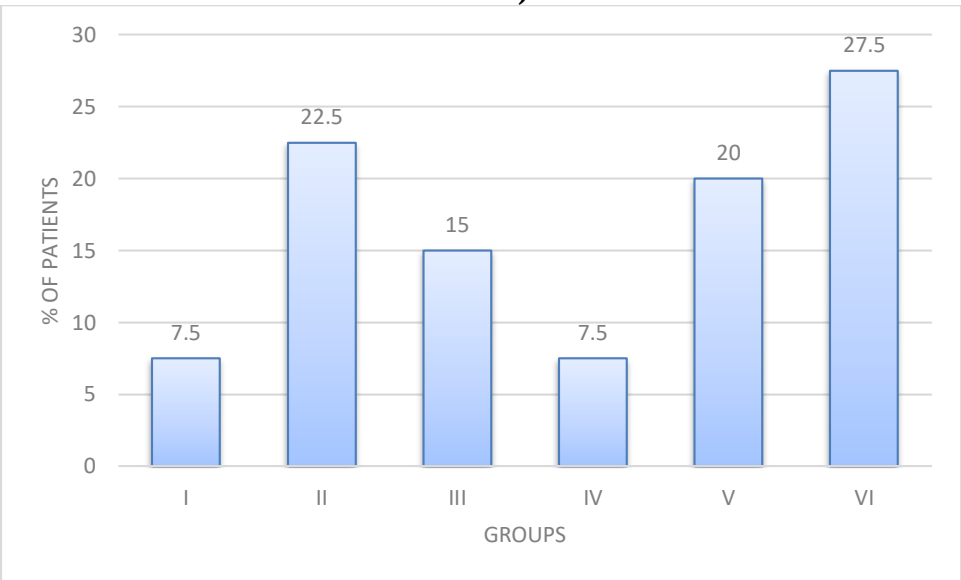


Table 16: Distribution Of Complication In DKA Patients

COMPLICATION	No of patients(n=40)	Percentage
Hypogylcemia	3	7.5
Cerebral edema	0	0
Oliguria	1	2.5
Pulmonary edema	1	2.5
Hypokalemia	15	37.5

Graph 16: Distribution Of Complication In DKA Patients

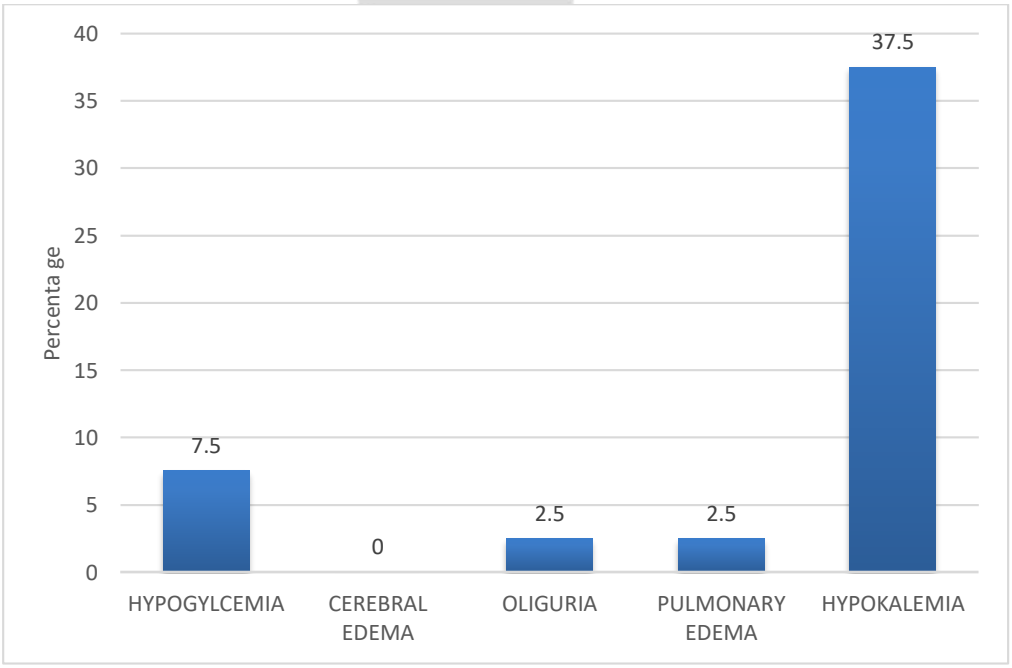
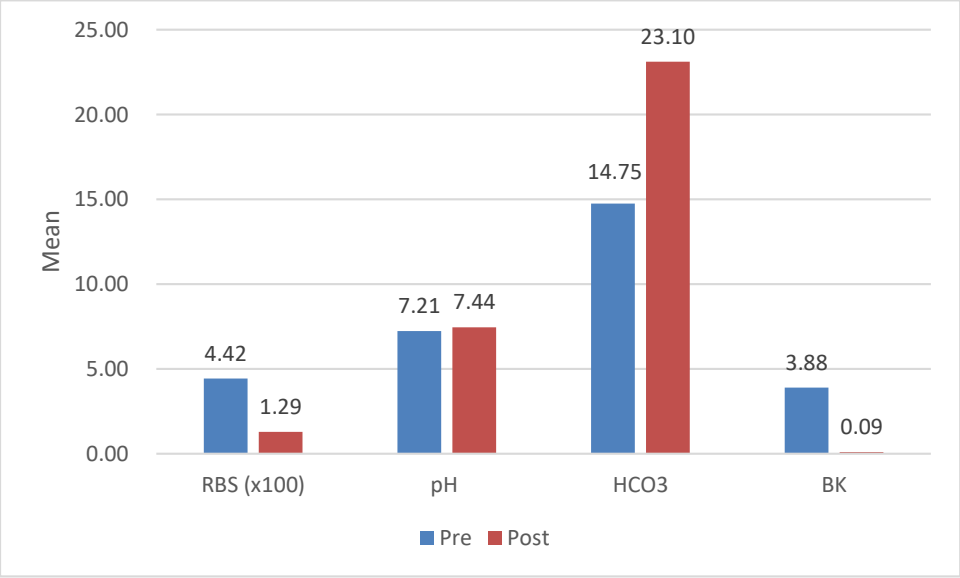


Table17:Comparison Of Biochemical Parameters Pre And Post Treatment

Measurement	PRE TREATMENT		POST TREATMENT		Mean Red	P-value*
	Range	Mean±SD	Range	Mean±SD		
RBS	252-600	441.8 ± 138.34	90 -175	128.98 ± 20.39	312.82 ↓(70.8%)	< 0.0001
pH	6.83-7.48	7.21 ± 0.16	7.33 - 7.54	7.44 ± 0.05	0.23 ↑(3.2%)	< 0.0001
HCO3	2.50-26.20	14.75 ± 6.75	17.10 -27.70	23.10 ± 2.10	8.35 ↑(56.6%)	< 0.0001
BK	0.60-12	3.88 ± 2.75	0.0. - 0.2	0.09 ± 0.07	3.79 ↑(97%)	< 0.0001

**Paired t-test*

Graph17:Comparison Of Biochemical Parameters Pre And Post Treatment



Discussion

In our study of 40 patients with diabetic ketoacidosis (DKA), 2 had Type 1 diabetes mellitus (DM) and 38 had Type 2 DM, reflecting the higher hospital admission rate of T2DM patients. Males constituted 63% and females 37% of the study population. The patients' ages ranged from 25 to 91 years, with a mean age of 58.38 ± 18.45 years, indicating early diagnosis in adulthood. The duration of diabetes ranged from 1 to 25 years, with 45% of patients diabetic for over 10 years and a mean duration of 10.7 years. Most patients (35%) had HbA1c levels between 11–13%, and 5 patients had levels above 16%, often due to age, poor compliance, and lack of regular monitoring. Socioeconomically, 40% were from the lower-middle class and 2.5% from the lower class as per the Modified Kuppuswamy scale. Only 3 patients had previous DKA episodes, mainly due to poor compliance.

Regarding treatment history, 42.5% were on oral hypoglycemic agents (OHAs), 10% on insulin, 35% on both, and 12.5% on no medication. Nausea/vomiting (60%) and abdominal pain (37.5%) were the most common symptoms, while fever (45%) and dehydration (30%) were frequent signs. Infections were the leading precipitating factor (52.5%), particularly lower respiratory tract (33.3%) and urinary tract infections (23.8%), followed by poor compliance (30%) and pancreatitis (15%). Two patients on SGLT2 inhibitors were suspected of developing DKA due to the medication, which was subsequently discontinued.

Most DKA cases were mild, with 20% showing more severe forms but without emergency-level presentations. Insulin requirements varied, with 40% needing over 100 units and 17.5% needing 26–50 or 76–100 units. Infusion therapy lasted more than 72 hours in 27.5% of patients, 13–24 hours in 22.5%, and 49–72 hours in 20%. Common complications included hypokalemia and hypoglycemia, both seen in 37.5% of patients due to insulin therapy.

Conclusion

DKA is treatable with better outcome if identified early by certain clinical features like Nausea/vomiting , abdominal pain fever,dehydration ,shortness of breath and altered sensorium.Infection, poor compliance and pancreatitis were the common most precipitating factor .The most commom type of infection were lower respiratory tract infection and the urinary tract infection .The majority of patients were in the lower middle class of the socioeconomic classification.the insulin therapy should monitered carefully as it may lead to the complication of hypokalemia and hypoglcemia.there was good significance between the before and after treatment of the Diabetes ketoacidosis

List of References:-

1. Denise R.Ferrier, Lippincott's Illustrated Reviews Biochemistry 6th edition, pg: 337.
2. Balmier A, Dib F, Serret-Larmande A, et al. Initial management of diabetic ketoacidosis and prognosis according to diabetes type: a French multicentre observational retrospective study. *Ann Intensive Care*. 2019;9(1):91.
3. Seth P, Kaur H and Kaur M,Clinical Profile of Diabetic Ketoacidosis:A Prospective Study in a Tertiary Care Hospital JCDR, 2015 Jun, 9(6):oc01-oc02
4. Shahid W, Khan F, Makda A, Kumar V, Memom S and Rizwan A, Diabetic Ketoacidosis:Clinical Characteristics and Precepitating Factors:Cureus12(10):e10792. DOI 10.7759/cureus.10792
5. Mali VT, Kavthekar SO, Verma S, Kurane AB, Patil NB, Kulkarni SP. Clinico-Epidemiological Profile of Diabetic Ketoacidosis in Hospitalised Children at a Tertiary Health Care Centre. J Nepal Paediatr Soc. 2021;41(2):147-53
6. Al-Obaidi A, H, Alidrisi H, A, Mansour A, A: Precipitating Factors for Diabetic Ketoacidosis among Patients with Type 1 Diabetes Mellitus: The Effect of Socioeconomic Status. Int J Diabetes Metab
2019;25:52-60.
7. Bedaso A, Oltaye Z, Geja E, Ayalew M. Diabetic ketoacidosis among adult patients with diabetes mellitus admitted to emergency unit of Hawassa university comprehensive specialized hospital. BMC Res Notes. 2019 Mar 14;12(1):137.
8. Sivanandan S, Sinha A, Jain V, Lodha R. Management of diabetic ketoacidosis. Indian J Pediatr. 2011 May;78(5):576-84. doi: 10.1007/s12098-010-0294-8.
9. Taye GM, Bacha AJ, Taye FA, Bule MH, Tefera GM. Diabetic Ketoacidosis Management and Treatment Outcome at Medical Ward of Shashemene Referral Hospital, Ethiopia: A Retrospective Study. Clin Med Insights Endocrinol Diabetes. 2021 Apr 12;14:11795514211004957.