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Research Article

A CROSS-SECTIONAL PROSPECTIVE OBSERVATIONAL STUDY ON PREVALENCE OF DYSELECTROLYTEMIA IN TYPE 2 DIABETES MELLITUS PATIENTS

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ABSTRACT

Background: The purpose of our study is to determine the prevalence of dyselectrolytemia in people with type 2 diabetes. Patients with diabetes frequently experience electrolyte imbalances, which may raise their risk of morbidity and mortality. Complex pharmacological regimens may be given to DM patients, some of which may be linked to electrolyte abnormalities. To minimize electrolyte problems in diabetic patients, it is crucial to stop using these medications whenever possible and maintain strict glycemic control.

Objectives: The main objectives include

- To Estimate the number of patients with type 2 DM having dyselectrolytemia.
- To determine the attributed cause of dyselectrolytemia in type 2 DM patients.
- To evaluate the comorbidities and to check if it is associated for causing dyselectrolytemia.
- To study the anti-diabetic drugs taken by type 2 DM patients and to determine if it is attributing to dyselectrolytemia.

Results: One hundred and fifty inpatients and fifty outpatients with type 2 diabetes mellitus were analysed for the presence of dyselectrolytemia. Most of the patients were over the age of 50 and had comorbidities such as hypertension, CAD, and CKD. The electrolyte levels were evaluated, and hyperkalemia and hyponatremia were found to be the most common among inpatients, while hyponatremia was most common in Outpatients.

Conclusion: To conclude it is clearly seen from the results that the majority of the type 2 DM patients were significantly found to have Dyselectrolytemia. And it is observed that Biguanides and insulin were the most commonly used antidiabetic drugs and many patients also used a combination of antidiabetic with other drugs such as diuretics, and antihypertensives.

INTRODUCTION

Diabetes refers to a set of metabolic illnesses that alter the way the body utilizes blood sugar (glucose).It is caused by defects in insulin production, insulin action, or both, which leads to high blood sugar levels (hyperglycaemia). The eyes, kidneys, nerves, heart, and blood arteries are only some of the organs that can be damaged by hyperglycaemia over time.[1-5]

There are various processes that can lead to the development of diabetes. These include defects that cause resistance to insulin action and autoimmune death of pancreatic beta cells, both of which result in insulin shortage. The underlying problem in diabetes is a deficiency in insulin action on target tissues, which causes abnormal metabolism of carbohydrates, fats, and proteins. This deficiency can be caused by inadequate insulin secretion or a diminished response of the target tissues to insulin. In many cases, both impaired insulin secretion and defects in insulin action occur in the same patient and it can be challenging to determine which the primary cause of hyperglycaemia is.[1,7,8] The symptoms of severe hyperglycaemia include increased urine output (polyuria), excessive thirst (polydipsia), weight loss, sometimes with increased appetite (polyphagia), and blurred vision. Long-term uncontrolled diabetes can also lead to growth impairment and an increased risk of infections. Acute complications of uncontrolled diabetes include diabetic ketoacidosis or nonketotic hyperosmolar syndrome, which can be life-threatening.[9,10] Eye disease (retinopathy), kidney disease (nephropathy), nerve disease (peripheral neuropathy), foot ulcers, amputations, and Charcot joints, and autonomic neuropathy (gastrointestinal, genitourinary, and cardiovascular symptoms, and sexual dysfunction) are all long-term complications of diabetes. People with diabetes also have an increased risk of developing cardiovascular, peripheral arterial, and cerebrovascular disease

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as well as hypertension and abnormalities in lipoprotein metabolism.[11-14]

Diabetic patients often have imbalances in electrolytes, especially when their diabetes is not well controlled (decompensated). This can lead to a lack of potassium, magnesium, and phosphate, as well as changes in sodium levels. The most common cause of high potassium in diabetics is a condition called hyporeninaemic hyperaldosteronism.[15-18] Other factors that can contribute to high potassium levels include kidney problems, certain medications, high blood sugar, and insulin deficiency. Electrolyte imbalances are common in diabetics and can have serious health consequences. Treatment may involve adjusting medications, controlling blood sugar levels, and understanding the underlying causes of the imbalances.[19-23]

METHODOLOGY

Site of the study

The study was conducted in a tertiary care hospital, Hyderabad.

Study design

It is cross sectional prospective observational study.

Duration of the study

The study was conducted for a period of 6 months.

Source of data and materials

- Patient's data collection form.
- Patient's medical record and case sheets.

Inclusion criteria

- Patients above 18 years and below 80 years.
- Patients with known type 2 DM of any duration.
- Patients having comorbidities.
- Patient who are willing to give consent.

Exclusion criteria

- Pregnant and lactating women.
- Patients with type 1 DM.

Study procedure

- This is a cross sectional prospective observational study to estimate the prevalence of dyselectrolytemia in type 2 DM patients where the patients with type 2 DM was enrolled with their consent. Data will be collected through a patient data collection form and patient lab investigation report obtaining from the inpatients and outpatient department of care hospital.
- The data collected was analysed using statistical analysis to produce outcomes of the study.

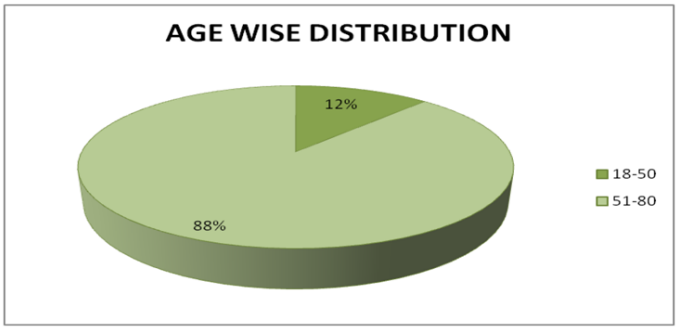
RESULTS

A total of 150 patients were enrolled, with 100 being inpatients and 50 being outpatients. The number of inpatients enrolled for the study are 63 males, 37 females and the number of outpatients enrolled are 25 males and 25 females.

Table 1 Age wise distribution

AGE (Yrs)	NUMBER OF PATIENTS(%)
18-50	12%
51-80	88%

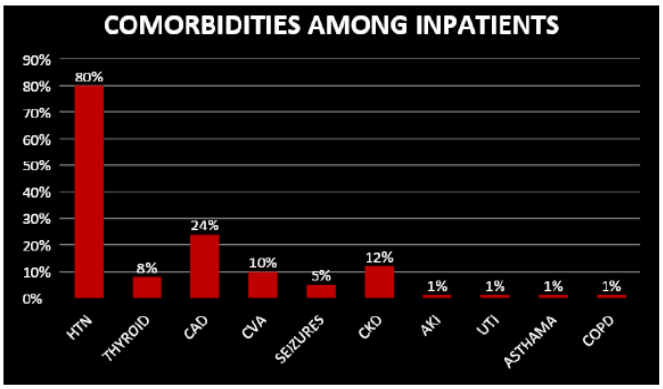
The sample size of 150 patients was categorized into two age groups - 12 % patients were from 18-50 years and 88% were from 51-80 years.



Graph 1 A Pie chart representing age wise distribution of subject

Table 2 Comorbidities

COMORBIDITIES	NUMBER OF PATIENTS (%)
HYPERTENSION	80%
THYROID	8%
CAD	24%
CVA	10%
SEIZURES	5%
CKD	12%
AKI	1%
UTI	1%
ASTHAMA	1%
COPD	1%

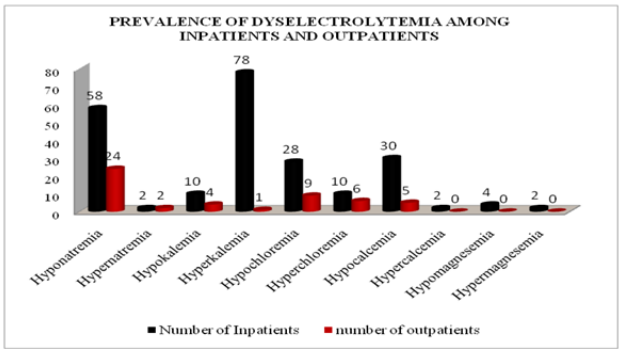


Graph 2 A bar graph representing types of comorbidities across all patients

It represents comorbidities among patients, with hypertension accounting for the majority of cases (80%). Coronary Artery Disease is the second most common disease, accounting for 24% of all cases followed by Chronic Kidney Disease with 12% cases, Cerebrovascular Accident with 10%, Thyroid with 8%, and seizures with 5%. Acute Kidney Injury, Urinary Tract Infection, Asthma and Chronic Obstructive Pulmonary Disease accounted least with 1% each.

Table 3 Prevalence of dyselectrolytemia among Inpatients and outpatients

ELECTROLYTES	NUMBER OF INPATIENTS	NUMBER OF OUTPATIENTS
HYPONATREMIA	58	24
HYPERNATREMIA	2	2
HYPOKALEMIA	10	4
HYPERKALEMIA	78	1
HYPOCHLOREMIA	28	9
HYPERCHLOREMIA	10	6
HYPOCALCEMIA	30	5
HYPERCALCEMIA	2	0
HYPOMAGNESEMIA	4	0
HYPERMAGNESEMIA	2	0

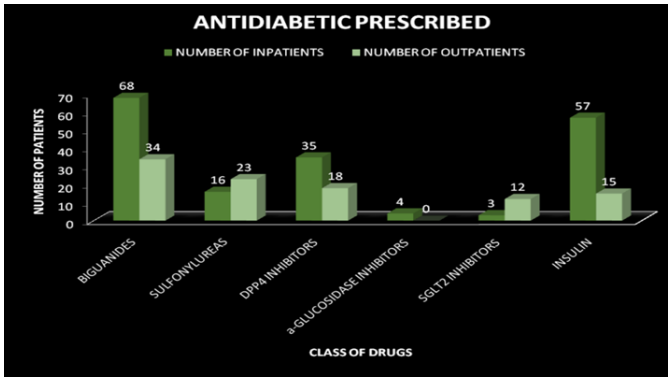


Graph 3 A bar graph representing the prevalence of dyselectrolytemia in type 2DM patients.

We examined the electrolyte levels of all inpatients and discovered that the majority of patients i.e. 78 patients had hyperkalaemia with an average electrolyte level of 5.4 mEq/L, with the next highest number of patients i.e. 58 patients having hyponatremia with an average electrolyte level of 128.7 mEq/L, followed by the lowest number of patients with hypernatremia. And among outpatients, the highest number of patients i.e. 24 patients had hyponatremia, and 9 patients had hypochloremia.

Table 4 Antidiabetics prescribed

Class of Drugs	Number of Inpatients	Number of Outpatients
Biguanides	68	34
Sulfonylureas	16	23
DPP4 Inhibitors	35	18
a-Glucosidase Inhibitors	4	0
SGLT2 Inhibitors	3	12
Insulin	57	15



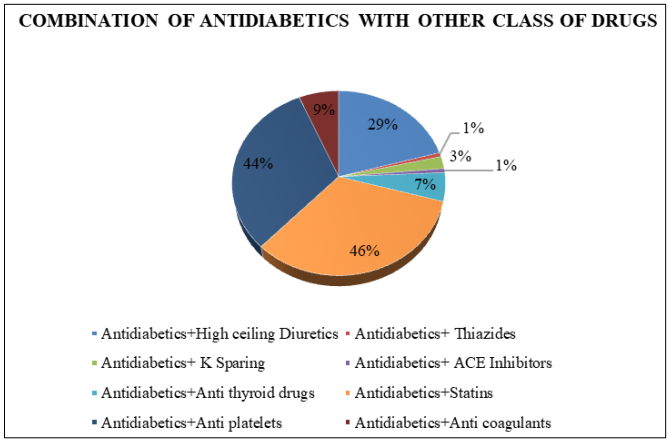
Graph 4 A bar graph representing the antidiabetics prescribed

According to our study, Biguanides are the most common class of drug used by 68 patients, followed by Insulin in 57 patients and among out-patients biguanides are the most common class of drug used by 34 patients, and Insulin by 15 patients.

Table 5 Combination of antidiabetics with other class of drugs used by in-patients

Combinations	Number of PTS (%)
Antidiabetics+High Ceiling Diuretics	29%
Antidiabetics+ Thiazides	1%
Antidiabetics+ K Sparing	3%
Antidiabetics+ Ace Inhibitors	1%
Antidiabetics+Anti Thyroid Drugs	7%
Antidiabetics+Statins	46%
Antidiabetics+Anti Platelets	44%
Antidiabetics+Anti Coagulants	9%

The most common combinations analysed are Antidiabetics along with Statins for 46%, Antiplatelets for 44%, High ceiling diuretics for 29% patients

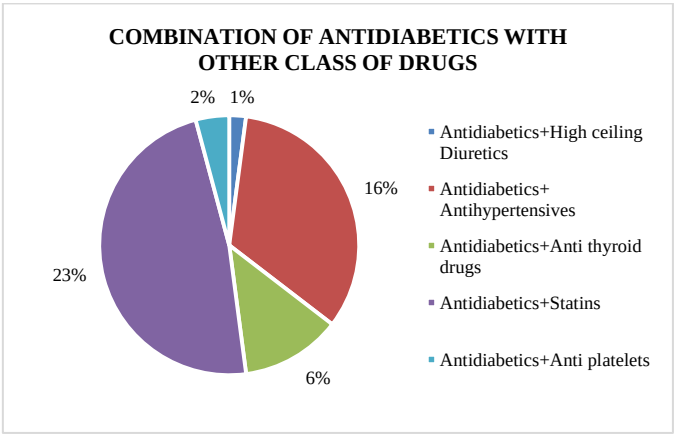


Graph 5 A pie chart representing combination of antidiabetics with other class of drugs used by in-patients

Table 6 Combination of antidiabetics with other class of drugs used by out-patients

Combinations	Number of PTS (%)
Antidiabetics+High Ceiling Diuretics	1%
Antidiabetics+ Antihypertensives	16%
Antidiabetics+Anti Thyroid Drugs	6%
Antidiabetics+Statins	23%
Antidiabetics+Anti Platelets	2%

The most common combinations analysed are Antidiabetics with Antihypertensives for 16%, Statins for 23%.



Graph 6 A pie chart representing combination of antidiabetics with other class of drugs

Upon analysing the data, it is evident that majority of the patients with type 2 diabetes mellitus have dyselectrolytemia. Hyperkalaemia being reported the highest followed by

hyponatremia and hypernatremia being the lowest. The most common class of antidiabetic used by these patients is biguanides and insulin.

DISCUSSION

We conducted an observational study over a 6-month period with 150 people who had type 2 diabetes mellitus and dyselectrolytemia. Finding the prevalence of dyselectrolytemia among type 2 DM patients was the major aim of our study. Taking this into consideration, we assessed the electrolyte levels of all the patients. Biguanides and insulin were the two most widely used anti-diabetic medications, and many patients also took medication for other illnesses like hypertension and hyperlipidemia.

Electrolytes are elements that are crucial for physiological and biochemical processes, including as acid-base balance, osmotic control, renal excretion, cardiac muscle contraction, and neuromuscular excitability. The two main ions in ECF (Extra-Cellular Fluid) are Na+ (sodium) and Cl- (chloride), whereas K+, Mg2+, and phosphates are primarily found in intracellular fluid. Sodium-Potassium ion (NA+- K+) pump that is controlled by catecholamine and insulin.[23,24] Elevations or decreases in insulin and catecholamine levels alter the concentration of electrolytes in the blood. The causes that have been suggested by which fluid and solute changes take place in hyperglycemic persons include variations in the total amount of extracellular solute, osmotic dieresis, intake of water taken by thirst, and impacts from linked situations.[24]

Hyponatremia was the most typical electrolyte imbalance identified in this previous studies as well. According to various studies, there is a considerable variation in the incidence of hyponatremia among hospitalized participants, ranging from 5 to 35%.[21,26] Hyponatremia caused by medications like insulin, diuretics, etc. is occasionally more common as a chronic presentation. Recent research has shown that dyselectrolytemia, particularly hyponatremia, is a significant risk factor for higher mortality in hospitalised patients.[27]

Hyponatremia was more likely to develop in patients with uncontrolled blood sugar, as expected, maybe as a result of the kidney's incapacity to govern normal physiological processes or as a result of an imbalance in the ADH (Antidiuretic Hormone) and Renin-Angiotensin system.

As comparison to diabetic individuals who were not elderly, hyponatremia occurred more frequently in the elderly. Similar results were seen in investigations by Abhisek Singh *et al*, where the prevalence of hyponatremia was 27%.

However, Namama Talabani, McNair P *et al* and George Liamis *et al* revealed opposing findings, i.e., hyponatraemia in diabetes mellitus.[28,29,30]Hypernatremia may occur as a result of poorly managed DM.[31]

In individuals with uncontrolled DM, blood sodium content varies depending on the equilibrium between water moving out of cells due to hyperglycemia, which lowers sodium, and osmotic diuresis, which increases sodium.[31]

Our study was single-centred and carried out in a small sample size reflecting more on Inpatients and less on outpatients. Further studies are required to evaluate the potential cause of dyselectrolytemia in diabetes mellitus patients and to be updated with its increasing number of cases.

CONCLUSION

Patients with type 2 DM are at risk for dyselectrolytemia, with hyponatremia and hypokalemia being the most common electrolyte abnormalities. To minimize electrolyte problems, it is important to stop using causative medications, replace with better agents, and maintain strict glycemic control. Patients with diabetes frequently experience electrolyte imbalances, which may raise the risk of morbidity and mortality. Complex pharmacological regimens, some of which may be linked to electrolyte abnormalities, may be given to DM patients. It is evident that majority of the patients with type 2 diabetes mellitus tend to have dyselectrolytemia, with hyperkalemia being the highest prevalent followed by Hyponatremia and then Hypermagnesemia, Hypercalcemia, Hypernatremia being the lowest. The most common class of antidiabetic used by these patients is Biguanides and insulin. Combinations of antidiabetic drugs with other drugs, such as diuretics, antihypertensives, and antithyroid drugs, were also evaluated and found that the majority of the type 2 DM patients were significantly found to have Dyselectrolytemia due to multiple comorbidities and it is observed that Biguanides (metformin) was mostly linked to dyselectrolytemia.

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