

## Electrolyte Profile Modulation: An Assessment in Diabetic, Hypertensive and Comorbid State

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### ABSTRACT

*Diabetes Mellitus and Hypertension are two non-communicable diseases that are known to be very common with increasing morbidity and mortality rate. Complications arising from Diabetes and Hypertension have raised great concerns and especially for those in Comorbid condition. We assessed the electrolyte profile of patients in the different condition and in Comorbid State. Electrolytes Sodium, Potassium, Chloride and Bicarbonate were determined using Ion Specific Electrode from serum sample of patients. Data was analyzed with two-way analysis of variance (ANOVA). At P value of <0.05 as our confidence limit we observed a significant difference between controls and patients for all conditions except bicarbonate in comorbid. The findings are suggestive of Electrolyte imbalance that must be incorporated into our management schedule of diagnosis for these conditions.*

### Keywords

Electrolytes, Diabetics, Hypertensives, Comorbid.

### Introduction

On a global scale, both diabetes mellitus and hypertension are ranked highly among the non-communicable diseases with a concomitant rising prevalence, morbidity and mortality. The rising incidence is associated with the complications of the disease connecting major organs of the body. Diabetes mellitus is understood as a condition in which there is hyperglycemia caused by absolute or relative deficiency of insulin secretion or utilization. Apart from genetic factors, some environmental factors are also known to cause diabetes. These includes industrialization that has been attributed to be responsible for elevated intake of calorific consumption resulting in overweight, obesity and body mass index [1].

Complications that develop in Diabetes mellitus have been extensively studied and include nephropathy, neuropathy, retinopathy and coronary heart disease [2]. In tandem with this development, there is a clustering of cardio metric risk factors and hyperinsulinemia, which have potential of cardiovascular disease

prompting with long-term complications for the kidneys, eyes and the nervous system.

The knowledge that pancreatic B-Cells are sensitive to cytotoxic alteration caused by reactive oxygen species has elicited awareness on the fact that the motivation for gene expression and the functions of antioxidant enzyme such as glutathione peroxidase is lowered in cells. The release of reactive oxygen species and the consequent reduction in the antioxidant defense mechanism are known to aggravate oxidative stress [3]. It is known that in diabetes free radicals produced reactive species excessively caused by glucose oxidation, degradation of glycated protein and non-enzymatic glycation products.

Hypertension occurs globally and is known to be one of the risk factors in cardiovascular disease. In assessing hypertension, serious consideration is given to ensuring that detection of organ derangement and other factors are included. Prolonged levels of hyperglycemia is known to lead to loss of large volume of body fluid, high serum osmolality, high risk of developing nervous system dysfunction and vascular collapse. As earlier shown by [4,5] patients with diabetes are at high risk of cardiovascular event. This risk is however strengthened when there is co-existent hypertension.

Electrolytes occur in body fluids and are also ingested from food, drinks and supplements. Electrolytes in solution becomes ions and inherit capacity to conduct electricity. They are very essential components in several body homeostatic processes such as fluid volume regulation, osmotic regulation and acid base balance [6]. The cardiovascular system is also not spared by the dilapidating effects of oxidative stress since it comes with altered concentration of nitric oxide availability, lipoprotein alteration and various forms of inflammatory response.

In this research, we have evaluated the patterns of Electrolyte profile in Diabetes, Hypertension and Patients in Comorbid condition.

### Materials and Method

Two hundred samples were collected in two tertiary hospitals, Federal Medical Centre and Niger Delta University Teaching Hospital in Yenagoa, Bayelsa State, Nigeria. Sample collection was based on selection criteria, which was restricted to known Hypertensive diabetic, and non-diabetic Normotensive subjects who gave their consent.

Five milliliter of blood was collected from each subject and transferred into a plane bottle. Sample was allowed to clot and was spun at 3000 rpm for five (5) minutes. The supernatant serum was separated and stored at -20°C until when it was used for the analysis of Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup> and H<sub>2</sub>CO<sub>3</sub><sup>-</sup>.

The method used for the analysis was by the Ion-Selective-Electrode (ISE) Selectra Pros Clinical Chemistry Analyzer, (a product of ELI Tech Group N.V Van Rewselaerweg 4.6956. AVS Pankeren, the Netherlands. Serial No 9683).

### Result

Values obtained from the analysis of samples are presented in tables 1, 2 and 3. Statistical method used was Anova, SPSS version 18-20 software. The software was used for basic work tabulation, inferences and association. Calculations were done to obtain the mean and standard deviation, F and P values.

**Table 1:** Mean and standard deviation of serum electrolytes of Diabetics and Non-Diabetics under study.

Parameters	Control Healthy Persons (n=50)	Diabetes patients (n=50)	P-values
Sodium (mmol/L)	136.60 ± 5.63	133.16 ± 4.43	.0001*
Potassium (mmol/L)	3.88 ± 0.30	3.92 ± 0.71	.0901
Chloride (mmol/L)	100.56 ± 2.04	104.56 ± 5.49	.0020*
Bicarbonate (mmol/L)	21.24 ± 2.62	19.40 ± 3.62	.0000*

**Key:** \* represent significant differences observed p<0.05.

Result revealed that the concentration of serum sodium in diabetics was significant (p<0.001) lower compared with the control group (133 ± 4.43 Vs 136.60 ± 5.63) serum potassium level was however insignificant at p<0.05.

**Table 2:** Mean and standard deviation of serum electrolyte levels of Hypertensive Patients and control under study.

Parameters	Control Healthy Persons (n=50)	Diabetes patients (n=50)	P-values
Sodium (mmol/L)	136.60 ± 5.63	133.16 ± 4.43	.0001*
Potassium (mmol/L)	3.88 ± 0.30	3.13 ± 0.71	.031
Chloride (mmol/L)	100.56 ± 2.04	103.78 ± 4.31	.001*
Bicarbonate (mmol/L)	21.24 ± 2.62	21.96 ± 5.16	.711

**Key:** \* represent significant differences observed p<0.05.

The result revealed that the concentration of serum sodium levels in the hypertensive patient (133.16 ± 4.43) was significantly (p=0.000) lower compared with the control group (136.60±5.63). Serum bicarbonate was slightly higher in hypertensive group.

The concentration of sodium in comorbid patient (133.12 ± 5.46) was significantly (P<0.05) lower when compared with diabetes patients (133.16 ± 4.43) and hypertensive (133.16 ± 4.43). Chloride did not reveal significant difference.

### Discussion

Diabetes mellitus and hypertension are two non-communicable diseases that have defied treatment although efforts at management have been intensified. Until now, there are still critical questions about comorbidities and clinical heterogeneity [7-9]. The needs for the development of implementable framework for effective quantitation as it relates to risks, age and gender in diabetics and hypertension have become relevant.

Comorbidity have been reported in Parkinson disease and in Depression to be high in Diabetes. Moreover marked correlation of comorbidity between type 2 Diabetes and schizophrenia sleep, disorder and congestive heart failure has been reported [10-12].

Our study have revealed facts that correlate with some previous findings. Sodium and bicarbonate were observed to be lower in diabetics patients when their values were compared to non-diabetics. We also observed elevation of chloride and potassium ions in diabetes mellitus.

We observed reduced sodium and potassium levels in hypertensive patients when their results were compared with controls. Serum bicarbonate did not show a significant difference when comparison was made for hypertensive and control. However, values for the comorbid for potassium, chloride and bicarbonate were significantly higher. Our findings in this work are in tandem with [12-14].

It has been earlier documented that hypertension is a highly sex-sensitive comorbidity with female showing reduced symptoms at fertile age and raised levels at post-menopausal. These supports the fact that hypertension is a strong risk factor for cardiovascular morbidity and mortality especially in patients with diabetes. By lowering blood pressure (BP) to 135/85 mmHg the goal for treatment can be achieved. In cases where the blood pressure is sustained above recommended target, drug therapy could be initiated with caution. It has been known that substances that block

**Table 3:** Multiple comparisons of the serum electrolytes of Diabetics, Hypertensives and comorbid under study.

Parameters	Control (n=50)	DN (n=50)	HTN (n=50)	CMB (n=50)	F-value	P-value
Na <sup>+</sup> (mmol/L)	136.60 ± 5.63	133.16 ± 4.43	133.16 ± 4.43	123.12 ± 5.46	4.115	.009*
K <sup>+</sup> (mmol/L)	3.88 ± 0.30	3.92 ± 0.71	3.73 ± 0.71	3.95 ± 0.60	0.553	.47*
Cl (mmol/L)	100.56±2.04	104.56±5.49	103.76±4.3	104.16±5.30	4.131	.008*
HCO <sub>3</sub> (mmol/L)	22.14 ± 2.62	19.40 ± 3.62	21.96 ± 5.16	22.20 ± 3.28	2.80	.044*

**Key:** \* represent significant difference observed p<0.05.

DM: Diabetes Mellitus; HTN: Hypertension; CMB: Comorbidity.

the renin-angiotensin-aldosterone system (RAAS) represent the key antihypertensive for use [15,16].

Our results have shown that there is an overall prevalence of electrolytes disorder in comorbid conditions of diabetes and hypertension.

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