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Oral Water Hydration May Impact Hematocrit and Blood Sugar Levels in Patients with Diabetes Mellitus

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ABSTRACT

Introduction: Patients of diabetes repeatedly need blood glucose measurement, which may be falsely high due to less water intake and poor hydration of the patients.

Aims & Objectives: To determine the effect of water intake or hydration on hematocrit and blood sugar levels in patients with diabetes mellitus.

Place and Duration of Study: Pathology Department and Diabetic Center of Sheikh Zayed Hospital, Rahim Yar Khan from January 2023 to July 2023.

Material & Methods: It was a cross sectional study conducted in total 75 Type-1 & Type-2 diabetes patients using convenient sampling technique. 5 ml blood samples were drawn before and 20 minutes after oral hydration with 500 ml of oral water in all these patients to determine the effect on hematocrit and blood sugar levels. The data was entered and analyzed on SPSS version 23. Pre and post observations were compared using paired t-test. p-value<0.05 was taken as statistically significant.

Results: The mean value for age and BSR (before and after) of study subjects was 46±11 years, 200±97 mg/dl, and 199±94 mg/dl (p=0.8) respectively. While mean value of HCT before hydration was 39±5.8% and after hydration was 38±6.4% (p=0.006).

Conclusion: Oral water hydration impacted mean hematocrit values in diabetic patients, significantly lowering them whereas their mean BSR values remained unaffected.

Keywords: Diabetes, Hematocrit, Hydration, Blood Sugar.

INTRODUCTION

Diabetes mellitus (DM) is a group of chronic, metabolic non-communicable disorders characterized by high glucose concentration, and has attained epidemic proportions, as the top ten causes of death worldwide[1,2]. The global prevalence of diabetes mellitus (DM) has surged due to changing lifestyles and increasing obesity. In 2017, the worldwide occurrence of DM reached 425 million and with advancing age, the prevalence of DM rose, affecting approximately 25% of the population aged 65 and above[3,4,5].

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Diabetes is a major contributor towards kidney failure, cardiovascular disease (CVD), blindness, and sometimes amputation. Acute complications encompass hyperglycemic hyper-osmolar state, hypoglycemia as well as hyperglycemic diabetic coma and diabetic ketoacidosis[6]. Chronic micro-vascular complications involve retinopathy, nephropathy, chronic macro-vascular complications and neuropathy, along with cerebro vascular and/or coronary artery disease (CAD), and peripheral artery disease (PAD)[4,5,6]. In healthy individuals, variations in water intake, even within the normal range, represent a crucial factor regulating vasopressin (VP) release. Low water intake increases VP secretion, and high water intake decreases it, all aimed at maintaining constant plasma osmolality[6].Clinical evidence indicates that a diabetic condition poses a potential risk factor for dehydration. Chronic hyperglycemia may elevate the risk of dehydration, leading to adverse outcomes for patients, including increased insulin resistance[7].Hematocrit, the proportion of blood volume occupied by red blood cells (RBCs), increases in dehydrated individuals. The body's hydration status can influence the levels of crucial hormones involved in energy intake, leading to reductions in the orexigenic hormone ghrelin[8].

From an observational standpoint, maintaining adequate plain water intake is typically linked to improved glycemic regulation. The impact of hydration status on glycemia holds implications for both clinical practice and research, given that fasting glucose concentrations and oral glucose tolerance tests (OGTTs) are commonly employed for diabetes diagnostics or to assess the effectiveness of interventions[9].Water, constituting 55-75% of the total body mass, stands as an indispensable component of the human body. Hypohydration leads to hemo-concentration, causing reduced thirst and poor ingestive behavior[10,11]. Such responses have been documented in reaction to hyper-osmotic and/or hypovolemic stimuli, along with dehydration[12]. Maintaining a consistent intake of water, a primary constituent of the body, is crucial for preserving good health, as the regulation of water balance intricately affects physiological processes[12,13]. The amount of water intake may alter blood glucose level by simple hemo-dilution or hemoconcentration[11].Considering this, it was hypothesized that poor water intake and thus poor hydration status of a diabetic patient may lead to hemo-concentration resulting in false high values of hematocrit and blood sugar. Additionally, as all the management strategies of DM revolve around reducing blood glucose level (glycemic control). If promoting a simple intervention of better hydration can reduce blood glucose levels significantly, it would be of great value in controlling hyperglycemia and avoiding complications. So, our study aimed to provide evidence on this, and was carried out to determine the effect of hydration on hematocrit and blood sugar level in patient with Diabetes Mellitus.

MATERIAL AND METHODS

It was a cross sectional study conducted on total 75 Type-1 and Type-2 diabetes mellitus patients for the duration of 7 months from January 2023 to July 2023 in Pathology Department and Diabetic Center of Sheikh Zayed Hospital, Rahim Yar Khan. Ethical approval was sought from Institutional Review Board (ref no:246/IRB/SZMC/SZH, dated;01-09-2021. Convenient sampling technique was done. Inclusion criteria taken was Type-1 or Type-2 diabetes mellitus patients of either sex, whereas exclusion criteria were diabetes patients having following complications or comorbidities like diabetic kidney disease, known patients of Ischemic heart disease, liver disease or patients taking some diuretic drugs. Variables included in this study were age, gender, type of diabetes mellitus, co morbidities.5 ml blood samples were collected in EDTA containing vacutainer vial and gel vial for hematocrit and glucose level before and 20 minutes after oral administration of 500 ml of water to each patient, for determination ofBSR and hematocrit levels. Hematocrit was measured on BT-Pro 21 three part Hematology analyser while blood glucose was performed on fully automatic chemistry analyzer Siemens Attelica. The data was entered and analyzed using SPSS version 23. Quantitative data was presented as mean and standard deviation (SD) and qualitative data as frequencies and percentage. Mean Blood Sugar Random and HCT values were compared by using Paired T-test among Type-1 and Type-2 diabetes patients and overall study population. P value of less than 0.05 was taken as significant.

RESULTS

The mean age of study subjects was 46±11 years and 93.3% of patients were married. The mean value of BSR before hydration was 200±97 mg/dl. The mean value of BSR after hydration was 199±94 mg/dl. Decrease in blood sugar level after hydration was observed. Mean HCT level before hydration was 39±5.8% and after hydration was 38±6.4%. So the level of hematocrit was also decreased after hydration. The percentage of patients of type 2 diabetes was 54 (72%) (Table-1). Overall BSR before hydration was 200±97mg/dl and after hydration was 199±94mg/dl (p-0.82) (Table-2). Overall mean hematocrit before hydration was 39±5.8% and after hydration was 38±6.4% (p-0.006). Table-3 shows that the patients with Type-1diabetes had a mean BSR of 232±75mg/dl and after hydration it was 234±88mg/dl (p=0.7) and mean HCT before hydration 39±4% and after hydration was 38±4.6 (p<0.001). The patients with Type-2 diabetes have a mean BSR before hydration 187±102 mg/dl and after hydration 185±9mg/dl (0.6) and mean HCT before hydration was 39±6% and after hydration was 38±7%. (p=0.07).

Types of DM	Frequency	Percentage
Type-1	21	28%
Type-2	54	72%
Total	75	100%

Table-1: Frequency of Type of Diabetes Mellitus.

Variable	Pre Hydration	Post Hydration
BSRmg/dl	200±97	199±94
HCT%	39±5.8	38±6.4

Table-2: Overall Pre & Post Hydration mean blood sugar random and mean hematocrit in patients.

Variable		Pre Hydration	Post Hydration	Mean Diff	P-value
Type-1 Diabetes	BSR	232±75	234±88	2±26	0.7
	HCT	39±4	38±4.6	-1±1.3	<0.001
Type-2 Diabetes	BSR	187±102	185±94	-2±30	0.6
	HCT	39±6	38±7	-1±3.5	0.07

Table-3: Pre & Post Hydration mean BSR & mean Hematocrit with Type-1 & Type-2 Diabetes.

DISCUSSION

In current study 75 patients of Type-1 and Type-2 diabetes mellitus were included for assessing the effect on hydration after 20 minutes of water intake on Blood sugar level and hematocrit (HCT). It was hypothesized that diabetic patients undergo repeated blood sugar testing for management and control of purposes, which may be affected by the hydration status of the diabetic patients, as low water intake can cause hemo-concentration which may lead to a falsely high level of blood sugar levels. This may lead to over treatment in terms of high insulin or oral drugs dose in the prescription. The results of our study, however, did not show a remarkable effect of hydration on blood glucose level. It did show mainly a decreasing trend in blood sugar after hydration but with statistically non-significant difference. However, it showed a statistically significant reduction in hematocrit, which hints that in a study with larger sample size and with post hydration value of BSR and HCT determined beyond 20 minutes of water intake a further reduction can be envisaged. A prior investigation indicated that, in healthy adults, an acute episode of mild dehydration did not affect blood sugar control. However, physiological reactions to mild dehydration led to an increase in concentrations of copeptin, as equal to levels observed in individuals suffering from diabetes, resulting in a heightened blood sugar response[10]. Another study, exploring the impact of hydration and dehydration through loss of acute body mass, found that hormonal markers related to glycemic regulation remained unaffected, with no changes in circulating insulin levels but a potential increase in glucagon[12]. Similarly, a study inducing a hyperosmotic state through hypertonic saline infusion demonstrated a higher percentage of glucagon and significantly elevated concentrations of glucose at specific time points when determined through glucose tolerance test (GTT). Insulin levels, however, remained unchanged. Moreover, a significant increase in water intake appeared to reduce serum copeptin (a surrogate marker for arginine vasopressin) and lower glucagon levels among individuals classified as "water responders," while insulin and glucose levels remained constant[13]. A parallel study in the United States revealed that plasma concentrations of glucose, insulin, growth hormone (GH), insulin-like growth factor-1 (IGF-1), and insulin-like growth factor-binding protein-3 (IGFBP-3) did not exhibit significant changes before and after hydration, both at rest and post-exercise[14]. The variations in glycemic regulation seem to hinge on particular individual's water intake habit and, potentially, their basic levels of copeptin/arginine vasopressin (AVP). However, uncertainties persist relative to the precise role of hydration in regulating the glucose levels and also the mechanisms involved in it. The observed population differential responses among diabetics as well as non-diabetics might be influenced by factors such as glucose levels in diabetics because of temporary medication discontinuation. A similar study was also conducted in University of Indonesia about hemoglobin and hematocrit which showed that both are values of concentration, hydration status affects hemoglobin and hematocrit equally[15]. A previous study showed that a patient having excessive fluid in his/her blood showed reduced levels of both hematocrit and hemoglobin, whilst patients having fluid loss have elevated levels for both hematocrit and hemoglobin. This also hints on the possibility of diluting effect of hydration status on blood sugar levels as well[16]. Another study also suggested that a low total water intake in patients with Type 2 Diabetes impairs blood glucose response to cortisol[17].

CONCLUSION

This study showed that the mean random blood sugar values among diabetic patients were not significantly lowered after hydration. However mean hematocrit values displayed significant lowering after hydration. It is suggested that a study with larger sample size and a post hydration sample time of more than twenty minutes may

give a truer value of the blood sugar level of diabetes patients.

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