

Original article

Study the Effect of High HbA1 Levels on Kidney and Liver Function

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ABSTRACT

Background and aims. Diabetes is a lifelong disease. It is necessary to understand the comorbidities that can be associated with high blood sugar levels. This study was aimed to assess the effect of high HbA1 (hemoglobin subunit alpha 1) on liver and kidney functions in diabetic patients in Al-Jabal Al-Akhdar - Libya. **Methods.** Blood samples from 18 patients with high HbA1 and 37 with normal values of HbA1 for residents of Al-Jabal Al-Akhdar in the laboratories in Al-Bayda city/Libya were analyzed, during the period from January to December 2022. The levels of liver, kidney functions and HbA1 was analyzed using kits and tests were estimated by a kit method in spectrophotometer. **Results.** The results showed that the first group of subjects without cumulative diabetes confirmed no significant differences compared to the second group of diabetic patients who had high results for HbA1. There were significant differences in the level of glutamic Oxaloacetic transaminase enzyme for the first group, compared to the second group. **Conclusion.** HbA1 should only be assessed in conjunction with fasting plasma, post-meal glucose, liver and kidney function tests for accurate monitoring of diabetes patients' long-term glycemic management.

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INTRODUCTION

Diabetes is linked to a number of illnesses, including liver dysfunction and an increased risk of hepatocellular carcinoma. [1]. Adults' liver enzyme functions are substantially correlated with commonly reported diabetic indicators like HbA1. It is likely that diabetes could be a predictor of liver health in the adults [2]. Since about ten years ago, liver damage has been acknowledged as a significant type 2 diabetes consequence [3,4]. Both the World Health Organization (WHO) and the American Diabetes Association (ADA) consider HbA1c the most accurate chemical test for controlling blood sugar in type 2 diabetes (T2DM) [5]. Alkaline phosphatase (ALP) levels are another marker of hepatocyte integrity in addition to aminotransferases [6].

Compared to other causes of renal failure, roughly 40% of diabetic patients eventually acquire kidney disease [7]. The diabetic affects the efficiency of the kidneys in removing toxins and excreting excess fluids from the body and thus their accumulation in the blood [8].

Many tests are considered guides to indicate kidney function and detect morbidity in diabetic patients, including measuring the concentration of urea, creatinine, uric acid, total protein, albumin and sugar, and HbA1 [9]. Tests for protein are indicators of kidney, liver disease, compared to other tests, the creatinine test is more accurate. Its concentration is influenced by age and weight, which alters the glomerular filtration rate and raises its concentration in situations of renal failure and urine retention [10]. Therefore, this study was aimed to assess the effect of high HbA1 on liver and kidney functions in diabetic patients.

METHODS

Study design and setting

This was a case control study involves 55 people diagnosed with symptoms related to height HbA1. All persons whose ages ranged between 16 to 86 years old visiting medical laboratories in the city of Al-Bayda from January to December 2022 were included.

Sample collection

About 5ml of venous blood sample was collected from each participant by the standard method, using the serum gel tube, and the serum was immediately separated by a precise centrifuge machine. Blood was analyzed for fasting glucose using glucose MR kit (LNEAR CHEMICALS, Montgat, Barcelona, SPAIN) and test HbA1. The serum was measured using immunoassay for the *in vitro* quantification of liver and kidney functions in human blood serum.

Study experiments

For liver function tests, blood was drawn and left to clot for 20 minutes at room temperature in a simple tube. Centrifugation was used to separate the serum for 10 minutes at 3000 rpm. All subjects underwent an automated analyzer kit method to assess their plasma levels of alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), and total bilirubin (direct and indirect bilirubin). Commercially available test kits (Analytic on Biotechnologies, Germany) were used with the manufacturer's instructions strictly adhered to using spectrophotometers (Humalyzer Junior).

For kidney function tests, all patients with high HbA1 and those without cumulative diabetes had blood drawn to determine serum creatinine levels. Determination of creatinine was based upon the Jaffe reaction with de-proteinization creatinine, in alkaline picrate solution forms a color complex [11], and serum urea which was determined enzymatically by using specific kits (Biomarhreb, Germany), using spectrophotometer (Humalyzer Junior) for both tests [12].

Statistical analysis

All data are expressed as mean \pm standard deviation (M \pm SD). Unpaired t-test was applied to test the significance of variance ($p < 0.05$) of the parameters under study between patients high HbA1 levels.

RESULTS

The results showed that people without cumulative diabetes had normal HbA1 (5.44 ± 0.966) compared to the high HbA1 level (9.10 ± 2.49) with those with high cumulative diabetes.

However, but it was observed when comparing the results of kidney function analyzes (Creatinine and blood urea) between people who had Normal HbA1, the ratio of creatinine analysis (2.35 ± 6.62) and blood urea analysis (26 ± 15.8) was higher. While, the percentage of creatinine analysis (5.2 ± 10.2) and blood urea analysis (25.2 ± 13.2) that there were no significant differences between the two groups in table 1.

Liver function results for total serum bilirubin (0.576 ± 0.426), direct bilirubin (0.214 ± 0.313), and indirect bilirubin (0.354 ± 0.243) analyzes for first group people who had normal HbA1 showed no significant differences compared to second group with high HbA1 results (Total serum bilirubin (0.647 ± 0.434), direct bilirubin (0.228 ± 0.208) and indirect bilirubin (0.428 ± 0.280)). It was shown that glutamic oxaloacetic transaminase (17.11 ± 6.60) for first group showed significant differences compared with second group (29.3 ± 19.4). Whereas, there were no significant differences between the results of alkaline in the first group (123.5 ± 65.3), glutamic pyruvic transaminase (17.6 ± 11.3) in comparison with second group, where the results of the analysis were alkaline was 163 ± 132 , and glutamic pyruvic transaminase was 21.11 ± 7.99 , as presented in table 2.

Table 1. Comparison of Kidneys function among the two groups

Test	Normal HbA1	High HbA1 patients	P-Value
HBA1C	5.44 ± 0.966	9.10 ± 2.49	0.000
Creatinine	2.35 ± 6.62	5.2 ± 10.2	0.293
Blood urea	26 ± 15.8	25.2 ± 13.2	0.831

Table 2. Comparison of liver function among the two groups

Test	Normal HbA1	High HbA1 patients	P-Value
HbA1c	5.44±0.966	9.10± 2.49	0.000
Total Serum Bilirubin	0.576±0.426	0.647± 0.434	0.568
Direct Bilirubin	0.214 ±0.313	0.228±0.208	0.842
Indirect Bilirubin	0.354±0.243	0.428±0.280	0.348
Alkaline ALP	123.5±65.3	163±132	0.249
Glutamic oxaloacetic transaminase GOT	17.11 ±6.60	29.3±19.4	0.018
Glutamic pyruvic transaminase GPT	17.6±11.3	21.11±7.99	0.190

DISCUSSION

In the current study, we analyzed the correlation between high HbA1 and liver and kidney function among patients with and without high cumulative diabetes. A single HbA1c test's valuable information has made it a trustworthy biomarker for the diagnosis and prognosis of diabetes [13]. HbA1 is a chronic disease that affects a large number of Libyan people and reflects the ineffectiveness of the body in using glucose properly [14], which leads to the sticking of red blood cells. Accumulated high blood sugar increases the risk of fatty liver disease and thus increases the risk of cirrhosis; The disease may progress to kidney disease and failure, because over the years, the cumulative rise in sugar leads to sluggishness and damage to the kidney's microfiltration system; However The ability to reflect the cumulative glycemic history of the previous two to three months makes HbA1c an essential biomarker of long-term glycemic control Therefore, patients with elevated levels of HbA1c need to have their liver and kidney function checked periodically every three to six month [2,15].

In this study, a clear association of HbA1 with liver enzymes was observed, the incidence of hepatocellular carcinoma has increased which is likely related to the increased prevalence of metabolic syndrome, along with obesity and type 2 diabetes mellitus (T2DM). which is in line with several other studies that showed a significant association of sugar with total bilirubin, ALP, GOT, GPT [2,16].

The findings of table 1 demonstrated a connection between height HbA1 and renal function. As a result, during diabetic nephropathy, both urea and creatinine are reliable indications that aid in determining kidney function, therefore higher blood glucose levels are linked to a rise in glycated hemoglobin, which in turn causes nephropathy, neuropathy, retinopathy, and cardiovascular disease [16]. Our research supported the statistical analysis of people with normal HbA1 levels and the statistically significant differences between their results and those of people with high HbA1c found in numerous other studies, which suggested that the rise in urea and creatinine levels is a result of high blood sugar levels brought on by insufficient insulin secretion [16,17].

The advancement of liver fibrosis has been linked to various putative biological causes, including elevated glucose [18] [19].

CONCLUSION

HbA1c tests considered a trustworthy biomarker for the diagnosis and prognosis of diabetes. We recommend future studies and expansion of the sample size in the analysis be performed in patients with elevated HbA1 that long-term affects renal and hepatic function.

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