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A clinical study of chronic liver disease patients with special reference to oral glucose tolerance test

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ABSTRACT

Fasting plasma glucose (FPG) levels or glycated haemoglobin (HbA1c) tend to be underestimated in diabetic patients with chronic liver disease (CLD), which masks the impaired glucose tolerance (IGT). In such cases, the oral glucose tolerance test (OGTT) is recommended to evaluate patients with suspected postprandial hyperglycemia who present with a normal FPG. This research aims to study the outcome of OGTT in CLD patients for early detection of diabetes in CLD patients and to find the correlation between OGTT and HbA1C levels in CLD patients. This cross sectional study was conducted for a period of 24 months from September 2019- August 2021 in Bangalore. The clinical manifestations, laboratory findings, HbA1c and OGTT in 50 cases of CLD was studied. Data was analysed using SPSS version 26. The mean age of patients was 45.46±11.1 years, most of the patients were male 86% (43) and 14% (7) were female. Anorexia was the predominant symptom with 84%. Alcoholism was the most common cause for cirrhosis (60%). Significant correlation was seen between HbA1c with fasting blood glucose, at ½ hour, at 1 hour, at 1 ½ hour and at 2 hours. CLD was more common in males and in lower socio-economic status. Alcoholism was most common in CLD. Most of the CLD patients were anaemic. There was a significant impaired response to glucose load in CLD. Abstinence from alcohol is important to prevent CLD. Early diagnosis and treatment of diabetes in CLD patients is important.

1. Introduction

Liver plays a central role in blood glucose regulation. It maintains a healthy level of blood sugar by a combination of gluconeogenesis, glycogenolysis, and glycogenesis [1]. Chronic liver disease (CLD) is a leading cause of mortality and morbidity across the world. CLD caused 1.32 million deaths in 2017, approximately two-thirds among men and one-third among women [2]. In India CLD accounts for 1.2% of hospitalization [3].

Disturbances of carbohydrate metabolism in CLD has been directly correlated with varying degree of hepatocellular dysfunction. It has been well established that impaired glucose tolerance (IGT) and insulin resistance (IR) often occur in patients with CLD [1].

The blood glucose levels are very low in fulminant acute hepatitis; however this is in contrast with CLD where the incidence of Diabetes mellitus (DM) nand IGT are of a significant percentage [4]. As CLD progresses to cirrhosis, the loss of liver function is exacerbated and leads to the deterioration of skeletal muscle. Early-stage cirrhosis with hepatogenous diabetes is characterized by marked postprandial hyperglycaemia and hyperinsulinemia. Advanced liver diseases manifest with metabolic derangements and this is regardless of the aetiology of the disease [5].

Oral glucose tolerance test (OGTT) can be used for assessing the glucose homeostatic power of the liver in CLD, where the reserve function is reduced as there are many factors that alter the glucose tolerance curves, for example infections, old age, drugs, and many other systemic diseases. Hence other evidence like previous history of DM, history of taking diuretics and other causes of glucose intolerance should be excluded before interpreting the glucose tolerance test. Glucose tolerance test in CLD shows discrepancies, s`ome show hypoglycaemia and few show hyperglycaemia [1].

HbA1C levels are falsely low in CLD patients due to the short life span of RBCs as a result of hypersplenism. Therefore, an OGTT is required for early detection of IGT or DM in CLD patients for timely management. Unfortunately, early diagnosis and optimal treatment of DM can be challenging, due to the lack of established clinical guidelines as well as the medical complexity of this patient population.

This study aims to study the outcome of OGTT in CLD patients for early detection of diabetes in CLD patients and to find the correlation between OGTT and HbA1C levels in CLD patients

2. Methodology

This was a cross sectional study conducted at a multi-speciality hospital, Bengaluru for a period of 24 months from September 2019 to August 2021. The study included 50 patients diagnosed with CLD between age group 18-65 years. Known cases of DM on hypoglycaemics, patients on drugs that might cause hypoglycemia or hyperglycemia, pregnant women, sepsis patients, chronic kidney disease patients and patients with congestive cardiac failure were excluded from the study. Informed consent form was received from the patients and ethical clearance was obtained from the ethical committee.

Data was collected regarding the patient's demography, anthropometry, clinical history, treatment history and investigations using a structured proforma. Height, weight was recorded and BMI calculated. OGTT was performed after ingestion of 75 grams of glucose as described by the WHO guidelines. Venous blood sample was taken at starting of the test and at one and two hours after ingestion of glucose. CLD diagnosis was based on Child -Pugh score or MELD score [6].

The data was collected and compiled in MS Excel and analysis was done. Descriptive statistics was used to present the data. Data was analyzed using SPSS (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp. Released 2019). Qualitative variables were expressed as frequency and percentages. Quantitative variables were expressed as mean and standard deviation. Tests of significance such as chi-square was used to test the association between socio-demographic variables with severity of symptoms and correlation coefficient was applied to determine correlation between age of participants and severity of symptoms.

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3. Results

Among 50 patients, most of them were found to be male 43 (86%) and 7 (14%) were found to be female. Many patients belonged to the age group of 31- 40 years (14, 28%) and 41-50 years (14, 28%), least number of patients 5 (10%) belonged to the age group of 20-30 years. Majority of the patients belonged to the lower class (class V) 33 (66%), followed by middle class (class III) 17 (34%) as shown in the table 1.

In most of the patients 30 (60%) ascites was commonly presented followed by hepatomegaly 28 (56%) and the least commonly presented sign was spider naevi (10, 20%) and esophageal varices (10, 20%) as shown in the table 2. Predominantly anorexia was noted in 42 (82%) patients followed by generalized weakness 39 (78%), least predominant was hematemesis 8 (16%). (Table 2).

The mean haemoglobin was found to be 10.22 gm% with SD of ±1.56. Highest heamoglobin value was found to be 13.3 gm % and lowest was found to be 7.8 gm %. Mean Total Count was 7682 with SD ±1988. Mean platelet count was 1,85,320 ±82149. Table 3.

Mean value of serum bilirubin was 1.8mg% ± 0.9mg% with highest being 4.4 mg% and lowest being 0.6 mg%. The mean value of serum albumin was found to be 2.89gm% ± 0.95gm% with highest being 4.6 gm % and lowest being 1.5 gm %. Mean value of globulin was found to be 2.26gm% ± 0.48 gm% with highest being 3.4 gm % and lowest being 1.3 gm%. Mean values of AST was 101.26 IU/L ± 58.64 IU/L, highest value being 252 IU/L and lowest value being 21 IU/L. Mean ALT was found to be 57.98 IU/L ± 26.4 IU/L, highest value being 124 IU/L and lowest value being 10 IU/L. Mean ALP was found to be 118.82 IU/L ± 41.89IU/L, highest value being 201 IU/L and lowest value being 45 IU/L. Table 3.

Mean serum urea was found to be 26.8 mg% ± 5.56 mg%. Mean Serum Creatinine was found to be 0.848 mg% ± 0.17 mg%. Mean sodium levels were found to be 139.88 mg% ± 3.3 mg%, mean potassium levels were found to be 4.07 mg% ± 0.41 mg%. Serum electrolytes were found to be well within normal limits. Table 3.

Among 50 patients subjected to the OGTT, by administration of 75 g of glucose in 300 ml of water and the plasma glucose levels were measured at 0, ½, 1 and 1½ hours. Normal glucose levels were recorded in 24 (48 %) patients followed by 13 (26 %) patients in each having IGT and diabetes mellitus, respectively. HbA1c was normal in 27 (54 %) patients of 50 patient, in 13 (26 %) patients there was IGT and in 10 patients DM as revealed in the Table 4. Significant correlation was seen between HbA1c with fasting, at ½ hour, at 1 hour, at 1 ½ hour and at 2 hours as shown in table 5.

4. Discussion

The liver functions to maintain normal blood glucose by different metabolic pathways, although it has been presumed that sensitivity of liver cells to insulin is responsible for the oral glucose uptake load by the liver [7], [8]. The pathogenesis of oral glucose intolerance in CLD has not been elucidated. It seems likely that impaired insulin secretion accompanies a defect in insulin sensitivity [9], [10] CLD has been associated with an increased risk for hyperglycaemia and DM. The diagnostic yield of common tests used to define diabetes in the general population differs from those with liver disease [11].

In this study, 86% (43) of the study subjects with CLD were male and 14%(7) of them were female. Similarly in a study by [3], 76% of the study subjects were male, 24% of them were female. In a study by [12] 56.6% of the subjects were male and 43.3% of them were female. In a study by [13] 67% were male and 33% were female. In the study by [14] 90% of the subjects were male. In present study the mean age

was 45.46± 11.1 years which was similar to studies by [12] (47.53 ± 5.82 years), [14] (46.9± 9.1 years) [3] (15), (45.42 years).

In our study it was seen that, 78 % of the study participants had a past history of alcoholism, 16% had no past history leading to chronic liver disease, 2% of them have a history of blood transfusion, 2% have had multiple sex partners and 2% of them have childhood liver disorders. In a study by [15] 60% of the study subjects had past history of alcohol usage. In another study by [16] 69.6% of the subjects had a history of alcoholism. In a study by [17] 34.3% of the chronic liver disease subjects had history of alcohol usage, 40.8% had no known past history akin to this study [17].

In the present study 30 (60%) study subjects had ascites similar to studies by [18] (69%), [19] (79%). In our study 56% of the subjects had hepatomegaly similar to a study by [20]. In another study by [19] 39% had jaundice. Oesophageal varices was observed in (20 %)10 patients similar to study by [19] (38.6%). The most common symptom in this study was anorexia 42 (84%), generalized weakness 39 (78%), distension of abdomen 30 (60%) and jaundice 24 (48%). The current study findings were similar to study by [3] anorexia (80%), abdominal distension (60%). In a study by [21] most common symptoms were jaundice and ascites.

Hyperbilirubinemia was seen in 52% in patients. Hypoalbuminemia was seen in 56% of the subjects. Serum creatinine was found to be within normal range for all cases and none of them were in hepato-renal syndrome.

In the present study, mean hemoglobin was found to be 10.22 gm% with SD of ±1.56. Highest hemoglobin value was found to be 13.3 gm % and lowest was found to be 7.8 gm%. In this study all the females (14%) were reported as anaemic and in males 91% were found to be aneamic. In a study by Frijo JA et al, 86.8% of the study subjects were found to be anaemic with a male preponderance which was in contrast to the present study [22]. In a study by [23] 66% of the study subjects were found to be anaemic and mean Hb was 12 gm% ± 2gm% SD. A high prevalence of anaemia due to either excessive bleeding or malabsorption or malnutrition among CLD patients warrants a need for further evaluation and management of anaemia in these patients as they are at an increased risk of complications like, hepatic encephalopathy (due to increased serum ammonia), fatigue, hepato-renal syndrome etc [14].

The prevalence of IGT in cirrhotic patients is highly variable owing to the differences in the stages and etiology of CLD and the diagnostic methods used [24]. The diagnosis of DM is either based on HbA1C or OGTT i.e. plasma glucose criteria, indicated by either the FPG levels or the 2-hour plasma glucose (2h-PG) value after the administration of 75 g of oral glucose [25].

In present study, 26% of the subjects were diabetic, 26% of them had IGT, and 48% of the subjects had normal glucose tolerance. This was consistent with a study done by [14] where 35% of the study subjects were diabetic, 42% had impaired glucose tolerance and 23% had normal glucose tolerance. In another study done by [3] 28% of the study subjects were diabetic, 36% of them had impaired glucose tolerance and 36% of them had normal glucose tolerance. In a study by [24] 27.6% of the 130 study subjects had diabetes, 10.7% had impaired glucose tolerance and 61.5% of them had normal glucose tolerance. Thus we can see the variable glucose tolerance due to the differences in the stages and etiology of chronic liver disease.

HbA1c is the gold standard for the measurement of long-range glycaemic control in patients with diabetes mellitus [26]. In this study, 54% of the subjects had <5.6 HbA1C levels, 26% of them had 5.7-6.4 HbA1C levels and 20% of them had levels >6.5. According to [27] the major advantages of HbA1C is the absence

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of a fasting requirement and the relative ease of sample handling. It is particularly useful as a marker for treatment effectiveness because it reflects average blood glucose over a period of months instead of a single point in time. While it remains a useful glycaemic marker in most patients with mild liver diseases, the accuracy and validity of HBA1c in patients with advanced liver diseases remains controversial. The poor diagnostic performance of HBA1c is attributable to the well-described curvilinear correlation between HBA1c and erythrocyte turnover which can occur in patients with CLD as a result of haemorrhage related to portal hypertension and coagulopathy, haemolysis caused by splenomegaly as well as impaired erythropoiesis due to marrow suppression and nutritional deficiency [28].

In a study by [14] 35% the subjects had HbA1C levels >6.5, a small study involving 15 patients with compensated cirrhosis found 40% of subjects to have HBA1c results below the non-diabetic reference range. Clinicians should be aware of the limitations of HbA1c as a parameter of glycaemic control in patients with chronic liver diseases. Future studies investigating new options for glycaemic monitoring in these patients are urgently required.

A recent European study showed that the prevalence of both insulin hyper secretion and insulin resistance increased with increasing BMI [29]. Thus, in obesity, higher insulin levels are necessary to maintain glucose tolerance, leading to increased stress on the beta-cells. However, data also suggest that underweight also predisposes people to develop T2DM [29]. In the present study, p value was 0. 159 and 0.78 for OGTT and HbA1C respectively. Hence, no significant association was found between BMI and Diabetes and HbA1C levels. A study by [30] found a close association between IGT and BMI equally in both low weight and obese participants which was in contrast to the present study.

Significant correlation was seen between HbA1c with fasting blood sugar, at ½ hour, at 1 hour, at 1 ½ hour and at 2 hours in our present study. A study Vani K also showed that there was correlation of HBA1c with Fasting blood sugar [31]. Hence, there is a need to evaluate further for ideal options for glycaemic monitoring.

5. Conclusion

Chronic liver disease is common in males and in low socio-economic status, cirrhosis is the most common cause of CLD. Among Liver function test, synthetic functions like serum bilirubin, serum albumin, serum globulin and prothrombin time are useful in assessing the functional reserve in chronic liver disease. Enzyme estimations like AST, ALT, AP etc., are useful in probable etiology of CLD. Most of the CLD patients tend to be anemic. There is significant impaired response to glucose load in CLD. Though HbA1c is a useful glycaemic marker in most patients with mild liver diseases, the accuracy and validity of it in patients with advanced liver diseases has remained controversial. Past history of alcoholism is one of the most common risk for CLD, therefore abstinence from alcohol is important to prevent CLD. Early diagnosis and treatment of diabetes in CLD patients is important to prevent further complications.

Limitations

This cross-sectional study has its own inherent limitations having taken purposive sampling technique which would not be a representative sample of all CLD patients and the sample size was suboptimal.

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Table :1 Demographic and socio-economic status of the patients

Variables		No of patients (n)	Percentage (%)
Gender	Male	43	86
	Female	7	14
Age	20-30	5	10
	31-40	14	28
	41-50	14	28
	51-60	11	22
	>60	6	12
Socio-economic status (Modified BG Prasad classification)	I	0	0
	II	0	0
	III	17	34
	IV	0	0
	V	33	66

Table 2: Presenting signs of symptoms of the patients

Signs & Symptoms		No of patients (n)	Percentage (%)
Signs	Ascites	30	60
	Hepatomegaly	28	56
	Icterus	26	52
	Clubbing	22	44
	Palmar erythema	14	28
	Splenomegaly	24	48
	Spider Naevi	10	20
	Gynaecomastia	22	44
	Hepatic Encephalopathy	12	24
	Esophageal varices	10	20
Symptoms	Distension of abdomen	30	60
	Fever	16	32
	Swelling of the limbs	13	26
	Anorexia	42	84
	Hematemesis	8	16
	Jaundice	24	48
	Generalized weakness	39	78
	Abdominal pain	17	34
	Nausea and Vomiting	18	36

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	Melena	12	24

Table 3: Laboratory parameters in patients

Lab parameters	Mean	SD
Haemoglobin (gm%)	10.22	1.56
Total Count	7682.00	1988.53
Platelet count	185320.00	82149.302
Bilirubin (mg%)	1.82	0.90
Albumin (gm%)	2.89	0.95
Globulin (gm%)	2.26	0.48
AST	101.26	58.64
ALT	57.98	26.40
ALP	118.82	41.89
OGTT Fasting	101.02	24.29
1/2 Hour	130.96	28.50
1 Hour	148.72	29.92
1 1/2 Hour	143.72	47.45
2 Hours	146.82	59.46
Urea (mg%)	26.80	5.57
Creatinine (mg %)	0.84	0.17
Sodium	139.88	3.305
Potassium	4.07	0.41

Table 4: Outcome of OGTT and HbA1c

Variables		No of patients (n)	Percentage (%)
OGTT response	Normal	24	48
	Impaired glucose tolerance	13	26
	Diabetes mellitus	13	26
HbA1c levels	Normal	27	54
	Impaired glucose tolerance	13	26

	Diabetes mellitus	10	20

Table 5: Correlation between HbA1c and OGGT

HbA1c	**OGTT**				
	Fasting	1/2 hour	1 hour	1 1/2 hour	2 hour
Correlation	0.909291	0.865204	0.896364	0.904868	0.903989
Degrees of freedom	49	49	49	49	49
P value	<0.0001*	<0.0001*	<0.0001*	<0.0001*	<0.0001*

*. Correlation is significant at the 0.05 level