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EVALUATION OF THE LIVER AND RENAL FUNCTION IN PATIENTS OF CHRONIC HEART FAILURE BASED ON THE BODY MASS INDEX: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Chronic heart failure (CHF) is known to affect hepatic and renal function adversely, but relevant Indian data is scarce. This study aimed to assess liver function tests (LFTs) and renal function tests (RFTs) of CHF patients and their relation to BMI status. **Methodology:** The retrospective study considered data of patients who consulted Madhavbaug clinics in Maharashtra, India between July-December 2018. Baseline LFTs and RFTs were analyzed wholly and based on BMI status, viz. normal-BMI, overweight and obese. **Results:** Of 147 patients, majority were males (74.15%) with mean age of 59.15±10.28 years. Based on BMI, three patient sub-groups were made: (56 with normal BMI, 60 were overweight and 30 were obese). Mean SGOT and SGPT were lower in obese group, but this was insignificant ($p>0.05$). Overall ALP was increased in all CHF patients but was comparable in all three sub-groups ($p>0.05$). Mean direct bilirubin were above-normal in all sub-groups, but mean total and indirect bilirubin were normal. Mean A/G ratio was normal in all sub-groups. Total serum protein was below normal in all sub-groups, being lowest in overweight group, but these findings were insignificant ($p>0.05$). RFTs, viz. BUN and serum creatinine, were normal and comparable in all sub-groups ($p>0.05$). **Conclusion:** Mild elevation in direct bilirubin and notable ALP elevations were seen in CHF patients but their RFTs were normal. Mean LFTs and RFTs were comparable in patients with normal BMI, overweight or obese patients, indicating lack of association between BMI and hepatic or renal function.

KEYWORDS: Liver function, Renal function, Body Mass Index, Heart Failure.

INTRODUCTION

Cardiovascular diseases (CVDs) are few of the commonest reasons for morbidity as well as mortality in the world, and India is no exception. According to available data, CVD is the commonest cause of death in India.[1] Chronic heart failure (CHF), which is reduced proficiency of the heart to pump the blood in the systemic circulation or inability to fill itself suitably with blood, affects about 10 million Indians.[2] The prevalence of CHF is about 1% in the country.[3]

CHF is associated with hepatic derangement due to liver congestion, which are generally asymptomatic but associated with deranged liver function tests (LFTs). Abnormal biochemical LFTs may be seen in CHF patients, but studies have shown variability in the findings. Also, if there are massive elevations seen in LFTs of CHF patients, these may be predictive of adverse outcomes.[4] There are studies based on the LFTs in CHF patients in the developed countries, but such data in the Indian setting in scarce.

Renal function is a known, but often neglected determinant of CHF prognosis.[5] Studies have reported that renal insufficiency may be associated with poor CHF outcomes.[6] However, there is a definite paucity of data with respect to the prevalence of renal insufficiency in CHF patients in the Indian context.

Body mass index (BMI), which is used to indicate the presence or absence of obesity in the population, is considered to be an important determinant of CHF risk and prognosis. Studies have shown that there is an increased risk of CHF development in patients with increased BMI.[7] Obesity, which is defined as BMI more than 30 kg/m2, is considered an important risk factor for development of hypertension (HTN), diabetes mellitus (DM) and dyslipidemia, all of which are diseases which worsen the CHF prognosis.[8] Literature search revealed that majority of CHF patients are obese, and this may be related to the impaired LFTs and RFTs in these patients.[9] However, the specific impact of increased

BMI on the RFTs and the LFTs have not been studied in detail.

In this retrospective study, we planned to assess the baseline LFTs and RFTs of CHF patients who visited the Madhavbaug clinics in India to tap the abnormalities in the hepatic or renal functioning. We also tried to assess these biochemical parameters based on the BMI status of the patients, after classifying the patients as those with normal BMI, overweight or obese.

METHODOLOGY

This retrospective study was conducted utilizing the data of patients who suffered from CHF and visited the Madhavbaug clinics in the Indian state of Maharashtra. These CHF patients visited the clinics for check-up between July 2018 to December 2018. The case record files of these patients were assessed for completeness of the baseline characteristics, viz. demographic details, anthropometric details, liver function tests (LFT) and the renal function tests (RFT). Data of only those patients was assessed who had completeness of the baseline records.

The CHF patients who came to the Madhavbaug clinics for the first time were subjected to general and systemic examination, followed by blood collection to assess the LFTs and the RFTs. The blood was collected from the antecubital vein and sent to the laboratory for reporting. The biochemical values obtained were then entered in the case records of these patients after the test reports arrived. The LFTs which were taken into consideration from the baseline clinical records included alkaline phosphatase, serum glutamic-oxalacetic transaminase (SGOT), serum glutamic-pyruvic transaminase (SGPT), serum bilirubin (total, direct and indirect), albumin to globulin ratio and total protein levels. The baseline RFTs which were checked for in the medical records included serum creatinine and blood urea nitrogen (BUN). The normal range for the LFTs and RFTs were considered from standard textbooks and published literature.[10,11] (Table 1).

The patients were classified based on the BMI as those having BMI in normal range, those who are overweight or obese based on the WHO classification followed worldwide. The BMI of between 18-24.9 kg/m2 were considered normal, between 25 to 29.9 kg/m2 were considered overweight while those above 30 kg/m2 were considered obese.[12] The mean RFTs and LFTs values were calculated separately for these three BMI sub-groups and then the mean values were compared.

Table 1: Normal Range for LFTs and RFTs.

SGOT (IU/L)	0-45
SGPT (IU/L)	0-35
ALP (IU/L)	30-120
Total bilirubin (mg/dl)	0.2-1
Direct Bilirubin (mg/dl)	<0.3
Indirect bilirubin (mg/dl)	<1
Albumin/Globulin ratio	1.5-2.5:1
Total protein (g/dl)	6.7-8.6
BUN (mg/dl)	7-20
Serum creatinine (mg/dl)	0.7-1.2

Data entry as well as coding was done in Microsoft Excel. Graphpad Instat software was utilized for data analysis. Categorical data was represented in the numeric form and continuous data was described as mean ± SD. The mean values of LFTs and RFTs were compared between the three subsets (normal BMI, overweight and obese) using Analysis of Variance (ANOVA) test. P value of less than 0.05 was considered statistically significant.

RESULTS

147 patients visited the Madhavbaug clinics between the study period and had all the relevant details present in the case records. The data of these 147 patients was included in the study for analysis. The demographic details were recorded, and it was found that most of the patients were males (109 patients, 74.15%). The mean age of the CHF patients included in the study was 59.15 years, with a mean weight of 69.21 and mean height of 1.6 meters, i.e. 160 centimeters. The mean BMI calculated for the patients was 26.69 kg/m^2 (Table 2).

Based on the BMI, the patients were classified as per the WHO guidelines in three categories; those having normal BMI, those who were overweight and those who were obese (Table 3).[12] 56 patients were found to have normal BMI, 60 patients were over-weight while the remaining 30 were found to be obese.

Table 2: Demographic Details of CHF Patients (n=147).	
Mean age (years)	59.15 ± 10.28
Median age (years)	59 (Range: 30-80)
Number of males	109 (74.15%)
Number of females	38 (25.85%)
Mean baseline weight (kg)	69.21 ± 14.39
Mean baseline height (meter)	1.6 ± 0.08
Mean Body mass index (BMI) (kg/m2)	26.69 ± 4.97

Table 3: Classification of patients based on BMI (n=147).		
Normal BMI (18.5-24.99 kg/m^2)	*Overweight (25-29.99 kg/m^2)*	*Obese (>30 kg/m^2)*
56	60	30

The mean values of all the LFTs and the RFTs were calculated based on the BMI-based subgroups and the comparison of these mean values was made between the three sub-groups. Amongst the LFTs, the mean SGOT and SGPT values were lower in the obese group, but this was not statistically significant ($p>0.05$). The overall ALP was increased in all the CHF patients. However, the mean ALP was comparable in all the three sub-groups ($p>0.05$) but was lowest in the normal BMI group. The mean direct bilirubin levels were found to be above the normal range in all the groups, but the total and the indirect bilirubin levels were in the normal range. Total bilirubin and indirect bilirubin were lowest in the obese group, and this was a statistically significant finding ($p<0.05$). The mean A/G ratio was found to be in the normal range, but the total serum protein was lower than the normal range in all the sub-groups. The mean A/G ratio was lowest but mean total protein was highest in the normal-BMI group, but these findings were statistically insignificant ($p>0.05$). The RFTs, viz. BUN and serum creatinine, were all in the normal range in all the groups, and comparable in the sub-groups ($p>0.05$). (Table 4).

Table 4: Comparison of Liver function test and Renal Function test according to BMI parameters in CHF patients.

Variables assessed	*Overall mean values (n=147)*	*Normal BMI (18.5-24.99 kg/m^2) (N=56)*	*Overweight (25-29.99 kg/m^2) (N=60)*	*Obese (>30 kg/m^2) (N=30)*	*P value*
SGOT (U/L)	31.03 ± 15.04	31.01 ± 14.07	32.79 ± 17.96	27.67 ± 9.32	0.56
SGPT (U/L)	26.36 ± 15.05	27.46 ± 17.95	26.12 ± 13.66	24.87 ± 11.87	0.62
Alkaline phosphatase (ALP)	213.87 ± 82.1	210.16 ± 96.22	216.25 ± 70.28	215.84 ± 78.48	0.47
Total bilirubin	0.94 ± 0.41	1.04 ± 0.39	0.93 ± 0.39	0.79 ± 0.42	<0.001*
Direct Bilirubin	0.34 ± 0.19	0.35 ± 0.14	0.34 ± 0.14	0.33 ± 0.31	0.43
Indirect bilirubin	0.59 ± 0.3	0.66 ± 0.27	0.59 ± 0.31	0.48 ± 0.28	<0.001*
Albumin/Globulin ratio	1.57 ± 0.65	1.49 ± 0.37	1.65 ± 0.86	1.56 ± 0.57	0.77
Total protein	6.6 ± 0.94	6.6 ± 0.94	6.44 ± 1.22	6.47 ± 1.35	0.8
BUN	12.71 ± 8.14	13.5 ± 7.74	11.76 ± 6.46	13.51 ± 11.6	0.71
Serum creatinine	1.12 ± 0.44	1.12 ± 0.34	1.14 ± 0.45	1.1 ± 0.59	0.43

DISCUSSION

Obesity is an important risk factor for CVDs including CHF, and BMI is an important indicator for imminent or prevalent obesity. Multiple studies have found that CHF patients having BMI higher than the normal range are at an enhanced risk of mortality.[13,14] Higher than normal BMI is related to the development of multiple metabolic diseases including HTN and DM. Hence, directly and indirectly, BMI affects the CHF development and prognosis. CHF is also known to affect the liver and the renal function of the body according to many studies published in the developed countries, but it is not clearly known whether the same can be said about Indian CHF patients. It is also not clear that whether BMI plays a role in the deranged LFTs and RFTs in the CHF patients. Hence, the authors decided to analyze the available baseline data to evaluate whether CHF patients showed any biochemical derangement in LFTs or RFTs, both as a whole as well as based on the BMI status of the patients.

The baseline LFT and RFT data of 147 CHF patients were analyzed. On evaluation of the whole data set, it was found that, out of the LFTs, the mean ALP and the mean direct bilirubin were raised above the normal range. The mean serum total protein was found to be mildly lowered in the CHF patients. However, the mean SGOT, mean SGPT, mean total bilirubin as well as indirect bilirubin, and the mean A/G ratio were in the normal range. An increase in the direct bilirubin is seen in parenchymal liver disease, which may be due to CHF. The mean ALP levels in this study were increased approximately twice the normal range. The increased central venous pressure (CVP) leads to passive congestion of the liver in CHF, which can lead to ALP elevation along with elevation of other liver enzymes.[4]

Another important reason for elevated liver enzymes is decreased hepatic perfusion due to reduced cardiac output in CHF, thereby causing hepatocellular damage and elevated liver enzymes and bilirubin. However, the ALP is a non-specific enzyme which may be raised in bile duct obstruction, cirrhosis or even in bone disease. Hence, the raised ALP may not be linked with CHF, in the presence of normal SGOT and SGPT. The decreased mean protein, which was mild, can also be physiological due to aging or due to decreased liver function. Once again, the change in serum protein is mild and hence, inconclusive.[15]

The RFTs which were noted down were serum creatinine and BUN, and both were in the normal range. This was in contrast to multiple studies in the western countries, which have shown that how long-term CHF can compromise renal functions. In a study by Tonelli et al., 33% of patients with CHF developed chronic kidney disease (CKD) in late life while the number was 32% in another study by Damman et al.[16,17] Just like for liver function, the main causes for compromised renal function in CHF patients are increased CVP and reduced renal blood flow. Initially, renal auto-regulation maintains the kidney function and this may be the reason why patients in our study had normal RFTs. However, glomerular filtration rate (GFR) declines over a period of time, and there is compromised renal function in the later stage of life.[18]

The mean BMI for the CHF patients in this study was 26.69 kg/m^2, falling in the overweight category.[12] 60 of the 147 patients were overweight, 56 of them fell in the normal BMI category while 30 of them were in the obese category. It was found that all the values, except total bilirubin and indirect bilirubin, were comparable in the three BMI categories. Even though the total and the indirect bilirubin were significantly lower in the obese class of CHF patients, the values in all the groups were in the normal range and hence this statistical significance was clinically irrelevant. In our knowledge, this is one of the first studies which has tried to assess the LFTs and RFTs in CHF patients, based on the BMI and hence, this study holds a novelty factor.

The study had a few limitations. The study was carried only in Western India, and hence patients of the whole country were not represented in the sample, creating region bias. Also, the sample size was low. A study with a bigger sample size, multiple centers and over a longer period may help in creating more robust evidence.

CONCLUSION

Mild elevation in direct bilirubin and notable elevations in ALP were seen in CHF patients but their RFTs were in the normal range. The mean LFTs and RFTs values were comparable in patients with normal BMI, overweight or obese patients indicating possible lack of association between BMI and hepatic or renal derangement in CHF patients. More evidence needs to be generated in Indian CHF patients to create stronger evidence with regards to the LFTs and RFTs in CHF patients.

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