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RESEARCH ARTICLE

Some Biochemical Parameters in Congestive Heart Failure Patients in Baghdad City

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Abstract

The present study was designed to study the changes on some biochemical parameters in males with congestive heart failure (CHF). Ninety males with age ranges from (27-73) years have been involved in this study, divided into two groups; the first group involved 65 males with CHF and the second group involved 25 males without CHF from Teaching Baghdad Hospital. The patient's groups were divided according to their age into three groups (less than 40, 40-50 and more than 50 years). Blood samples were collected from each patient and control and used for analysis of renal function parameters, potassium, calcium and liver function. The results of the current study showed a highly significant ($p < 0.01$) increase in the concentration of blood urea, serum creatinine in HF patients as compared with the control group. While there is non-significant difference in the level of potassium in HF patients compared with the control group. Further, there was a highly significant ($p < 0.01$) decrease in concentration of calcium in patients group compare with the control. This study also illustrates a highly significant ($p<0.01$) increase in the liver function parameters which include alanine aminotransferase (ALT) and aspartate aminotransferases (AST) of HF patients compared with the control group. While there is non-significant difference in alkaline phosphatases (ALP) of HF patients compared with control group. There was also significant ($P< 0.05$) increase in total serum bilirubin (TSB) concentration of HF patients compared with the control group.

Keywords: *Congestive heart failure, Urea, Creatinine, ALT, AST, ALP, TSB.*

Introduction

Heart failure can be described as an abnormality of cardiac structure or function leading to failure of the heart to deliver oxygen at a rate commensurate with the needs of the metabolizing tissues, despite normal filling pressures [1]. It is a main and growing public health problem, an increasing number of enzymes, biologic substances, hormones, and other markers of cardiac stress and breakdown, as well as myocyte injury (collectively referred to as biomarkers) appear to obtain growing clinical importance [2].

Heart failure (HF) has a variety of detrimental effects on different organs. Lately, the interactions between heart failure and the kidney have been the subject of significant interest and investigation [3]. Renal failure can affect cardiac performance leading to its failure which consequently worsens renal function.

Nearly half of all deaths in end-stage renal disease patients are attributable to cardiac causes [4].Because of the heart failure cause morbidity and mortality worldwide, therefore the present study aimed to investigate the changes of some biochemical parameters, such as kidney function and liver functions tests in males with congestive heart failure as compared with control.

Materials and Method

Study Population

The objective patients of this study were 65 male individuals from Teaching Baghdad Hospital, Baghdad, Iraq during the period between December 2016 to March 2017; with age range between 27 to 73 years. The patients diagnosed with congestive heart failure disease by the consultant's medical staff, according to symptoms and clinical examination.

Patients divided into three age groups which included less than 40, 40-50 and more than 50 years. A control group composed of 25 healthy males with the same age range.

Blood Samples

Blood samples were collected by venipuncture; five milliliters of blood were pulled from patients and control group. The blood placed in a plain tube, and left for 15 minutes at room temperature to clot. Then, it was centrifuged at 3000 rpm for 10 minutes by centrifuge to collect serum and preserved in the freezer at -20ºC until it was used in the biochemical tests.

Biochemical Parameters

Determination of Renal Function

Blood urea and serum creatinine were determined according to enzymatic methods (Linear Co., Spain). Serum potassium (Linear Co., Spain) and calcium (Aggape Co., Switzerland) were measured spectrophotometrically through a kinetic coupling assay.

Determination of Liver Function

Total serum bilirubin (TSB), alkaline phosphatase (ALP), Aspartate Aminotransferase (AST) and Alanine Aminotransferase (ALT) were determined using enzymatic kits (Aggape Co., Switzerland).

Statistical Analysis

The result was analyzed statistically using System (SAS) program, (2012). Then, the significance among means was tested depending on least significant difference (LSD) test (5).

Results and Discussion

The results of the present study in Table (1) showed a highly significant ($p < 0.01$) increase in the renal function parameters which include blood urea and serum creatinine of heart failure (HF) patients compared with the control group. The urea concentrations were 34.32 ± 1.06 and 53.97 ± 3.68 mg/dl in control and patients' groups, respectively, while the creatinine concentrations were 0.683 ± 0.03 and 1.154 ± 0.08 mg/dl in control and patients' groups, respectively.

The present study also illustrated non-significant differences in potassium concentrations of HF patients compared with control group. The concentrations of potassium were 4.068 ± 0.06 and 3.901 ± 0.08 mol/ L in control and patients, respectively. The results also demonstrated that there was a highly significant ($P< 0.01$) decrease in calcium concentration of HF patients compared with the control group. The calcium concentrations were 9.174 ± 0.07 and 8.702 ± 0.09 mg/dl in the control and patients, respectively.

Table 1: Renal function in heart failure patients and control groups

Groups	Renal function (Mean ± SE)			
	B.Urea (mg/dl)	S. Creatinine (mg/dl)	$S.K^{+}$ (mmol/L)	$S.Ca^{++}$ (mg/dl)
Patients (No. = 65)	53.97 ± 3.68	1.154 ± 0.08	3.901± 0.08	8.702 ± 0.09
Control (No. = 25)	34.32 ± 1.06	0.683 ± 0.03	4.068 ± 0.06	9.174 ± 0.07
T-test	11.905 **	0.281 **	0.261 NS	0.297 **
P-value	0.0015	0.0013	0.211	0.0022
** (P<0.01), NS: Non-significant.				

Concerning of the results in Table (2) also illustrate a highly significant ($p< 0.01$) increase in the level of blood urea in (more than 50) age group compared with the level of blood urea in (Less than 40), (40-50) age groups of HF patients. The concentrations of blood urea are 68.37 ± 5.97, 44.93 ± 3.79 and 31.41 ± 1.65 mg/dl in the control and the groups more than 50, 40-50 and less than 40, respectively. There is a highly significant ($p< 0.01$) increase in the level of serum creatinine between (more than 50) age groups compared with (less than 40) and (40-50) age group of HF patients. The concentrations of serum creatinine are 1.484 ± 0.14, 0.929 ± 0.08 and 0.668 ± 0.03 mg/dl in the control and the groups more than 50, 40-50 and less than 40, respectively. In concerning the result in Table (2) also reveal that there is a highly significant ($p< 0.01$) decrease in the potassium in (more than 50) age groups compared with (less than 40), (40-50) age group of HF patients. The concentrations of potassium are 3.578 ± 0.11, 4.195 ± 0.12 and

4.25 ± 0.10 mol/L in the control and the groups more than 50, 40-50 and less than 40, respectively. While there is a highly significant ($p< 0.01$) decrease in calcium concentration (more than 50) age groups compared with (40-50) and (less than 40) age groups HF patients. The concentrations of calcium are 8.372 ± 0.13, 8.84 ± 0.12 and 9.33 ± 0.08 mg/dl in the age groups (more than 50, 40-50 and less than 40) respectively.

Table 2: Renal function in heart failure patients at different age groups

Age groups (year)	Renal function (Mean ± SE)			
	B. Urea (mg/L)	S. Creatinine (mg/L)	$S.K^{+}$ (mmol/L)	$S.Ca^{++}$ (mg/L)
Less than 40	31.41 ± 1.65	0.668 ± 0.03	4.25 ± 0.10	9.33 ± 0.08
40-50	44.93 ± 3.79	0.929 ± 0.08	4.195 ± 0.12	8.84 ± 0.12
More than 50	68.37 ± 5.97	1.484 ± 0.14	3.578 ± 0.11	8.372 ± 0.13
LSD	17.085 **	0.408 **	0.361 **	0.405 **
P-value	0.0001	0.0002	0.0001	0.0001
** (P<0.01)				

The result of the present study showed a highly significant increase in renal function parameter (urea and creatinine) and these results were in accordance with previous studies [6, 7]. Which confirmed that renal dysfunction is highly prevalent in the HF population. Heart failure and kidney disease share common pathophysiological pathways which can lead to combined dysfunction, known as cardio-renal syndrome.

In heart failure patients, renal impairment is related to hemodynamic and non-hemodynamic factors. Both decreased renal blood flow and renal venous congestion due to heart failure could lead to impaired renal function [8]. The cardio-renal syndrome (CRS) was earlier utilized to describe a relatively normal kidney that is dysfunctional because of a diseased heart, with the assumption that in the presence of a healthy heart, the same kidney would perform normally.

Cardio-renal syndrome (CRS) is a pathophysiologic disorder of the heart and kidneys, whereby acute or chronic dysfunction in one organ stimulate acute or chronic dysfunction in the other organ [9]. Renal dysfunction, a frequent phenomenon in the setting of heart failure (HF) represents significant co morbidities and may cause to further deterioration of HF and worsened clinical outcomes [10].

Patients with acute or chronic heart failure (CHF) often have impaired renal function as well as elevated blood urea [7]. The pathogenesis of renal impairment in CHF is multi-factorial, but a main determinant is a disproportionate decrease in renal perfusion as a consequence of decreased cardiac output [11].

Reduced glomerular filtration rate (GFR) is a significant independent risk factor for all-cause mortality and morbidity in patients with chronic HF [6] .

Congestive heart failure is a mutual and crucial contributor to the progression of chronic renal disease. If we can aid to prevent renal dysfunction in heart failure, we are likely to be much more successful in dealing clinically with such patients. Therefore, close cooperation between cardiologists and nephrologists is needed [4].Hypokalemia is commonly observed in CHF subjects, and it is a strong independent predictor of mortality [12], Hypokalemia was defined as potassium level < 3.5 mmol/L at any study visit, while borderline hypokalemia was known as potassium level between 3.5 to 3.9 mol/L [13, 14].

It is common among patients with HF [12, 15]. Potassium (K^{+}) is a significant electrolyte essential for a healthy nervous system and a regular heart rhythm [16]. Hypokalemia contributes to the pathogenesis of cardiovascular disease, and many cardiovascular disorders and drugs cause hypokalemia [15].

In patients with congestive heart failure, aldosterone may reach plasma levels up to 60 times more than those measured in normal subjects [17, 18, 19] is common in HF patients, often due to a defect in Na^{+}/K^{+}-ATPase activity and intracellular shift of K causes by oxidative stress and neurohormonal activation. Hypokalemia is combined with ventricular arrhythmias and sudden cardiac death [15].Alteration in potassium ion may cause life-threatening arrhythmias. Although healthy individuals

are affected less, patients with HF receiving cardiac medications are susceptible to these effects of potassium like use of hydrochlorthiazides and loop diuretics [16].On the other hand, the results in Table (3) showed a highly significant increase ($p < 0.01$) in the liver function parameters which include AST and ALT of HF patients compared with the control group. The concentrations of ALT were 26.88 ± 1.32 and 38.63 ± 2.77 U/L in the control and patients' groups, respectively. The concentrations of AST were 25.60 ± 1.31and 38.65 ± 3.12 U/L in the control and patients' groups, respectively. While there is non-significant difference in ALP of HF patients compared with control group. The concentrations of ALP were 107.04 ± 4.92 and 116.38 ± 4.15 U/L in the control and patients' groups, respectively. Further, there was a significant ($P< 0.05$) increase in TSB of HF patients compared with control group. The concentrations of TSB were 0.656 ± 0.03 and 0.891 ± 0.06 mg/L in control and patients' groups, respectively.

Table 3: Liver function tests in heart failure patients and control groups

Groups	Liver function tests (Mean ± SE)			
	ALT (U/L)	AST (U/L)	ALP (U/L)	TSB (mg/L)
Patients (No. = 65)	38.63 ± 2.77	38.65 ± 3.12	116.38 ±4.15	0.891 ±0.06
Control (No. = 25)	26.88 ±1.32	25.60 ± 1.31	107.04 ±4.92	0.656 ±0.03
T-test	9.053 **	10.171 **	14.638 NS	0.204 *
P-value	0.0116	0.0125	0.2079	0.0239
* (P<0.05), ** (P<0.01), NS: Non-significant.				

Concerning the results in Table (4), there was a highly significant increase ($p < 0.01$) in the level of ALT in more than 50 age group compared with Less than 40 and 40-50 age groups of HF patients. The levels of ALT were 46.19 ± 4.19, 33.67 ± 4.52 and 27.16 ± 3.84 U/L in more than 50, Less than 40 and 40-50 age groups of HF patients respectively. There was a significant increase ($p < 0.05$) in the level of AST in more than 50 age group compared with less than 40 and 40-50 age groups of HF patients. The levels of AST were 46.94 ± 4.87, 33.81 ± 4.67 and 25.00 ± 4.72 U/L in more than 50, Less than 40 and 40-50 age groups of HF patients respectively. Table (4) also demonstrated a significant increase in ALP in more than 50 age group compared with less than 40 and 40-50 age groups of HF patients. The levels of ALP were 124.91 ± 6.22, 112.04 ± 7.48 and 101.25 ± 5.64 U/L in more than 50, Less than 40 and 40-50 age groups of HF patients respectively. While there is non-significant difference in TSB in all age groups of HF patients. The concentrations of TSB were 1.009 ± 0.09, 0.847 ± 0.11 and 0.655 ± 0.04 64 mg/L in more than 50, Less than 40 and 40-50 age groups of HF patients, respectively.

Table 4: Liver function tests in heart failure patients at different age groups

Age groups (year)	Liver function tests (Mean ± SE)			
	ALT (U/L)	AST (U/L)	ALP (U/L)	TSB (mg/L)
Less than 40	27.16 ± 3.84	25.00 ± 4.72	101.25 ± 5.64	0.655 ± 0.04
40-50	33.67 ± 4.52	33.81 ± 4.67	112.04 ± 7.48	0.847 ± 0.11
More than 50	46.19 ± 4.19	46.94 ± 4.87	124.91 ± 6.22	1.009 ± 0.09
LSD	13.974 **	15.764 *	20.480 *	0.394 NS
P-value	0.0112	0.0227	0.0494	0.1020
* (P<0.05), ** (P<0.01), NS: Non-significant.				

Congestive heart failure is a systemic clinical syndrome with a variety of potential effects on other organ of body systems. Recently, the interactions among heart failure and the kidney and bone marrow have been the subject of significant interest and investigation, but the interactions among heart failure and other organ systems have not been carefully studied [20].Liver function abnormalities are frequently found in patients with heart failure [21, 22].

The present study shows increase in the levels of AST and ALT, this is in accordance with previews studies [24, 20, 25, 26]. They confirmed that liver impairment is highly prevalent in the HF population. Abnormalities in liver function tests have been noted frequently in patients with chronic congestive heart failure [24]. A variety of liver abnormalities and 'cardio-hepatic syndromes' have been previously characterized in patients with heart failure, Passive hepatic congestion because of

elevated central venous pressure is believed to cause elevations of both direct and indirect serum bilirubin ('congestive hepatopathy') [20].

Increased levels of AST and ALT in heart failure have been attributed to hepatocellular injury from decreased perfusion, whereas especially elevated bilirubin levels, high ALP levels, and low ALT/ALP ratio in heart failure have been associated with cholestatic liver injury from an increased central venous pressure [22]. Impaired perfusion from decreased cardiac output is associated with acute hepatocellular necrosis ('hepatic ischaemia') with elevations primarily in serum aminotransferases [25].Our study illustrates increase level serum total bilirubin which also emphasized the importance of increase total bilirubin levels, whereas direct bilirubin, ALP, and GGT were also related to cardiac events [21]. Passive hepatic congestion, because of increased central venous pressure, is believed to cause elevations of both direct and indirect serum bilirubin ('congestive hepatopathy'), with nutmeg liver on pathology [20]. Pharmacological agents interfering with adaptive mechanisms in the hepatic and renal circulations: Angiotensin-converting enzyme inhibitors by interference with the local adaptive mechanisms may reduce the hepatic blood flow in patients with congestive heart failure; captopril, calcium antagonists, furosemide, and non-steroidal anti-inflammatory agents may have deleterious effects on the ischaemic kidney [24].

It is concluded from the present study that congestive heart failure causes a decline in renal function by increase urea and creatinine and decrease calcium concentrations. Further, liver functions were also influenced by heart failure through elevation in the activity of ALT and AST levels.

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