Response of Liver Function Tests to Aerobic Exercise in Patients with Type 2 Diabetes Mellitus

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Abstract

Background: The importance of aerobic exercise in the management of type 2 diabetes is well known. Liver function abnormalities are highly prevalent in diabetic patients due to high prevalence of non alcoholic steatohepatitis (NASH).

Aim of Work: To study the short term effects of light intensity exercise on liver function biochemical tests in patients with type 2 diabetes.

Subjects and Methods: Included patients were 50 type 2 diabetic patients and 20 normal controls. Diabetic patients were 20 males and 30 females, mean age was 43.9 ± 8.6y. Mean BMI was 32.07 ± 1.3 kg/m². Control group consisted of 9 males and 11 females, mean age was 41.4 ± 5.5y and mean BMI was 32.5 ± 0.4 kg/m². All patients and controls were subjected to light intensity bicycle based exercise for 20 minutes. A blood sample was withdrawn immediately before and immediately after exercise for assessment of serum AST, ALT, GGT, Alkaline phosphatase (Alk P), Total protein (TP) and albumin.

Results: Liver enzymes were found to be significantly higher in diabetic patients than in controls while serum albumin and total proteins were found to be significantly lower in diabetics both pre exercise and post exercise. Mean values of all liver function tests studied were found to be significantly higher post exercise in both diabetic patients and control group. Mean values of percent of changes of liver enzymes were significantly higher in control group than in diabetic patients while total proteins and albumin were found to be significantly higher in diabetic patients than in controls.

Conclusion: Light form exercise can cause immediate elevation of AST, ALT, GGT, Alkaline phosphatase, serum total proteins and albumin levels both in type 2 diabetic patients and in non diabetic subjects. No clear immediate effect of diabetes mellitus on changes of liver function tests post exercise could be detected.

Key Words: Exercise – Aerobic – Diabetes – Liver – Enzymes.

Introduction

DATA concerning the role of exercise in hepatic disorders are unclear. Post exercise changes in serum liver enzymes showed elevation in AST, ALT, GGT and alkaline phosphatase [1]. Liver function tests were significantly increased after weightlifting [2]. Another study found no increase in serum AST and ALT in patients with type 2 diabetes post exercise [3]. Hypoxia caused by the acute effect of exercise was postulated to explain hepatic affection post exercise which could be reflected on liver function tests [4].

On the other hand, people who exercise on regular basis not only feel better, but often respond more positively to medical treatment. In many cases, regular exercise delay the onset of complications associated with liver disease [5]. Moreover, regular exercise can be a valuable tool in the treatment of NASH and was found to improve liver functions and histology [6].

The possible benefits of physical activity for patients with type 2 diabetes are substantial and many studies proved the importance of long term physical activity programs both in prevention and treatment of type 2 diabetes [7]. Many forms of exercise, ie, aerobic, resistance, or combined training, were found to be equally beneficial in reducing HbA1C values [8]. It has been reported that insulin stimulation of IRS-1 phosphorylation and PI3 kinase activity are decreased while insulin action is enhanced following exercise. The post exercise increase in insulin action is observed equally both in insulin resistant and insulin sensitive states [9]. The liver helps to maintain normal blood glucose concentration in the fasting and postprandial states. Type 2 diabetes and glucose intolerance are very frequent in patients with NAFLD and they have...
included patients were all suffering from type 2 diabetes mellitus more than 2 years of diagnosis.

**Exclusion criteria:** The following patients were excluded: patients known to have hepatic disorders, cardiopulmonary diseases, severe diabetic neuropathy, retinopathy or peripheral vascular disease, patients with positive rapid test for HBsAg and HCV antibodies, patients receiving thiazolidinediones for control of blood sugar and patients with blood glucose level (150 mg/dl > fasting blood glucose >250 mg/dl).

All subjects of both groups were subjected to full history taking and clinical examination including measurement of body mass index (BMI). Measurement of fasting blood glucose was done for all patients on the day of exercise.

Measurements of liver function tests including serum level of Aspartate amino transferase (AST), Alanine aminotransferase (ALT), Gamma Glutamic transeptidase (GGT), Alkaline phosphatase (Alk P), total protein (TP) and albumin were done immediately before exercise session and immediately after. Biochemical measurements were done using Hitachi 917-Auto analyzer (Roch diagnostics-Germany).

Percent of changes post than pre exercise values were calculated as follows:

\[
\% \text{ change} = \frac{(\text{Pre exercise value}-\text{Post exercise value})}{\text{Pre exercise value}} \times 100
\]

**Exercise protocol:**

Exercise session was started immediately after withdrawal of blood sample using electronic bicycle ergometer (mod TF-6.2E China). The exercise session was a twenty minutes procedure that was divided into three stages.

**First stage (warming up):** Consisted of five minutes warming up in the form of pedaling at a speed of 60 revolutions/m without a load.

**Second stage (active stage):** Consisted of light intensity exercise in the form of pedaling at a speed of 60 revolutions/m with a load adjusted to achieve 11-12 reported effort using the Borg scale for rating of perceived exertion.

**Third stage (cooling down):** Consisted of five minutes of cooling down in the form of pedaling at a speed of 60 revolutions/m without a load [12,13].

**Statistical methods:** Numeric data were presented in the form of mean±SD. Categorical data were summarized in the form of frequencies. Comparison

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**Subjects and Methods**

This study was done on 70 subjects who were divided into two groups, group 1 included 50 patients with type 2 diabetes mellitus and group 2 consisted of 20 normal subjects. Demographic characteristics of patients are illustrated in Table (1).

Table (1): Demographic and laboratory characteristics of diabetic patients and control subjects. Comparisons between two groups are illustrated.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n=50)</th>
<th>Group 2 (n=20)</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y) (mean±SD)</td>
<td>43.8±5.3</td>
<td>41.4±5.4</td>
<td>0.09</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males (n %)</td>
<td>20 (40 %)</td>
<td>9 (45 %)</td>
<td></td>
</tr>
<tr>
<td>Females (n %)</td>
<td>30 (60 %)</td>
<td>11 (55 %)</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m(^2)) (mean±SD)</td>
<td>32.07±1.3</td>
<td>32.5±0.4</td>
<td>0.03</td>
</tr>
<tr>
<td>FBG (mg/dl) (mean±SD)</td>
<td>171.4±41.2</td>
<td>85.5±10.5</td>
<td>0.001</td>
</tr>
<tr>
<td>AST (n=0-3 7 IU/L):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-exercise (mean±SD)</td>
<td>40.6±30.09</td>
<td>20.5±7.8</td>
<td>0.004</td>
</tr>
<tr>
<td>Post-exercise (mean±SD)</td>
<td>45.4±30.97</td>
<td>24.3±10.3</td>
<td>0.004</td>
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<tr>
<td>ALT (n=0-41 IU/L):</td>
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<td></td>
</tr>
<tr>
<td>Pre-exercise (mean±SD)</td>
<td>37.9±32.3</td>
<td>16.9±9.6</td>
<td>0.006</td>
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<tr>
<td>Post-exercise (mean±SD)</td>
<td>40.4±36.9</td>
<td>19.2±9.4</td>
<td>0.001</td>
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<td>GGT (n=8-61 IU/L):</td>
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<td></td>
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<tr>
<td>Pre-exercise (mean±SD)</td>
<td>57.6±42.9</td>
<td>24.4±9.5</td>
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<tr>
<td>Post-exercise (mean±SD)</td>
<td>61.7±43.2</td>
<td>27.4±9.4</td>
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<td>Alk p (n=40-129 IU/L):</td>
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<tr>
<td>Pre-exercise (mean±SD)</td>
<td>103.2±56.08</td>
<td>62±18.3</td>
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<tr>
<td>Post-exercise (mean±SD)</td>
<td>107.2±54.1</td>
<td>70.3±18.3</td>
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<td>T. protein (n=6.4-8.3 g/dl):</td>
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<tr>
<td>Pre-exercise (mean±SD)</td>
<td>7.06±1.08</td>
<td>7.8±0.6</td>
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<tr>
<td>Post-exercise (mean±SD)</td>
<td>7.45±1.07</td>
<td>8±0.6</td>
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<tr>
<td>Albumin (n=3.5-5 g/dl):</td>
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<td></td>
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<tr>
<td>Pre-exercise (mean±SD)</td>
<td>3.22±0.56</td>
<td>4.2±0.4</td>
<td>0.001</td>
</tr>
<tr>
<td>Post-exercise (mean±SD)</td>
<td>3.5±0.53</td>
<td>4.5±0.5</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Table (1):** Demographic and laboratory characteristics of diabetic patients and control subjects. Comparisons between two groups are illustrated.
of paired data was done using paired sample t-test. Comparison of unpaired data was done using Mann-Whitney non parametric test. Pearson correlation was done to detect strength of association between variable. Statistical significance was considered at $p<0.05$. All $p$ values were two sided. Statistical analysis was done using Microsoft excel and SPSS version 11.0.

**Results**

Mean values of all measured liver enzymes were found to significantly higher in diabetic patients than controls while mean serum total proteins and albumin were found to be significantly lower in diabetics both pre and post exercise (Table 1). All measured liver function tests were found to have significantly higher mean values post exercise than pre exercise in both groups of patients (Figs. 1,2). Comparison of mean percent of change of liver function tests revealed significantly higher values for AST, ALT, GGT, Alkaline phosphatase and significantly lower values for albumin and total protein in control group than diabetic patients (Fig. 3). Mean age was not significantly different between groups. Age was not significantly correlated with any of the parameters of liver functions studied both in diabetic patients and control subjects. In addition, there was no difference between males and females in all parameters studied in both groups.

**Discussion**

Aerobic exercises are an important part of life style measures designed for treatment of diabetes mellitus [14]. Patients with type 2 diabetes are at increased risk of liver damage [15]. They have a higher incidence of liver function test abnormalities than individuals who do not have diabetes [16]. Chronic HCV infection has been linked to diabetes mellitus in several studies [17,18]. So the objective of this study was to evaluate the immediate effect of aerobic exercise on biochemical liver function tests in patients with type 2 diabetes. This objective was accomplished through a cross sectional study assessing ALT, AST, GGT, Alkaline phosphates, total protein and albumin both pre and post a light form of bicycle based exercise for 20 minutes. In the current study, all studied liver enzymes were found to be significantly higher in diabetic patients than controls. Individuals with type 2 diabetes had a higher incidence of liver function tests abnormalities. Mild chronic elevation of liver enzymes was
found to reflect insulin resistance which is an integral part of the pathogenesis of type 2 diabetes mellitus [19,20]. Non alcoholic fatty liver is one of the complications of diabetes mellitus that could present with elevated liver enzymes [21]. Serum albumin and total protein were found to be significantly lower in diabetic patients which could be explained by the well known effect of diabetic nephropathy causing albumin loss in urine even in the newly diagnosed cases [22]. Significant increase of all studied liver enzymes post exercise was found in our study both in diabetic patients and normal controls. These results go with what was found previously in elevation of liver function tests following exercise such as AST, ALT and alkaline phosphatases [23]. There is no consensus on what form of exercise can cause clinical change in liver function biochemical tests. Running [24] and weight lifting [2] were found to produce such an effect. In our study, serum albumin and total proteins were found to be significantly increased post exercise both in diabetic patients and controls. Expansion of plasma volume at the expense of extravascular volume was reported due to increased synthesis of plasma proteins mainly albumin post exercise resulting in increase in plasma oncotic pressure [25].

The significant elevation of all studied liver enzymes post exercise both in diabetic patients and controls found in our study did not signify a specific effect of diabetes on liver enzymes. Moreover, changes of liver functions post exercise were found to be significantly higher in control subjects. Both our diabetic patients and controls had a mild form of obesity with significantly higher mean BMI in control subjects than diabetic patients. Obesity was reported by many investigators to cause elevated levels of liver enzymes including ALT, AST, GGT and Alkaline phosphatase [26-29]. This presumed effect of obesity on liver enzymes in control group could be responsible for our failure to get a specific effect of diabetes on change of liver functions post exercise. Elevated ALT and AST activity were found to be associated with increased fasting insulin and not with obesity per se suggesting that the presence of insulin resistance, rather than BMI alone, plays a role in mediating the increased aminotransferase activity [30]. Fasting hyperinsulinemia is on of the pathogenic features that characterize insulin resistance which eventually progress to the frank form of diabetes mellitus [31].

Conclusion: Light intensity exercise can cause immediate elevation of AST, ALT, GGT, Alkaline phosphatase, total proteins and albumin serum levels both in patients with type 2 diabetes mellitus and in non diabetic subjects. No clear immediate effect of diabetes mellitus on changes of liver function tests post exercise could be detected. Further studies on a larger number of patients and with a longer follow up period are recommended to clarify this point.

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References


