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ORIGINAL ARTICLE

Cardiopulmonary exercise testing in patients with liver cirrhosis



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KEYWORDS

Liver cirrhosis;
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Abstract *Objectives:* To investigate the exercise performance and cardiorespiratory efficiency in patients with liver cirrhosis.

Background: Liver cirrhosis is a very common disease in Egypt especially post hepatitis type, it affects the quality of life and daily performance. It is associated with hypoxemia and impaired oxygen consumption.

Methods: This study was conducted on 30 patients of liver cirrhosis and 10 healthy subjects (control group), they were selected from the Menoufia University Hospital. All subjects were subjected to clinical history, clinical examination, plain chest-X-ray, blood sample for: complete blood picture, liver function tests, prothrombin time, abdominal ultrasonography and pulmonary function tests (spirometry) and cardiopulmonary exercise tests.

Results: The results of this study revealed a significant reduction of most parameters of exercise test and pulmonary function tests in cirrhotic group versus the control group. Prevalence of exercise impairment increased with the increase of the severity of liver cirrhosis.

Conclusion: (1) Cirrhotic patients have impaired exercise performance. (2) Prevalence of exercise impairment increased with the increase of the severity of liver cirrhosis.

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Introduction

Cirrhosis is defined histologically as a diffuse hepatic process characterized by fibrosis and the conversion of normal liver architecture into structurally abnormal nodules. The progression of liver injury to cirrhosis may occur over weeks to years [1]. Exercise capacity, which is also known as cardiorespiratory fitness and aerobic capacity, is the ability to consume and use

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oxygen during exercise [2]. Maximal exercise capacity and pulmonary gas exchange are both commonly impaired in liver cirrhosis. These impairments appear to be independent of the etiology of cirrhosis, but the data are equivocal with respect to their association with disease severity [3].

Aim of the study

The aim of the current study was to investigate the exercise performance and cardiorespiratory efficiency in patients with liver cirrhosis.

Methods

A written consent was obtained from all subjects prior to inclusion and the regional ethics committee of the Menoufia University hospital approved the study. The study was conducted in the Menoufia University hospital, and involved thirty patients with liver cirrhosis. The study also included ten healthy controls.

Study subjects were divided into 3 groups according to Child-Paugh classification: Group A, included 12 patients; Group B, included 11 patients; Group C, included 7 patients with liver cirrhosis. All subjects were subjected to clinical history, clinical examination, plain chest-X-ray, blood sample for: complete blood picture, liver function tests, prothrombin time, abdominal ultrasonography and pulmonary function tests, exercise test. In our study, the patients underwent pulmonary function tests (PFT) 3 times: before exercise, immediate and 30 min after cardiopulmonary exercise. Ten healthy volunteers who had no symptoms or signs of any chest disease and normal pulmonary function tests were included as a control group.

Results

The comparison of cirrhotic patients and the control group regarding pulmonary function test parameters revealed that, there was significant decline in FVC and V_t in the cirrhotic group versus the control group, while it showed non significant difference in FEV₁, FEV₁/FVC, PEF, RF between the two groups (Table 2). The comparison of cirrhotic patients and the control group regarding the cardiopulmonary exercise test parameters revealed that, there was significant difference in VO₂/kg %, METS %, VO₂/HR, Vd/ V_t and SpO₂ % regarding the comparison of cirrhotic patients and the control group,

while it shows non significant difference in Pet CO₂, Pet O₂, VE/CO₂ and VE/O₂ between the two groups (Table 2).

In this study, the comparison of oxygen uptake per kg ratio (VO₂/kg %) between the different groups of cirrhotic patients revealed that, there was significant difference between groups (A, B) and (A, C), (B, C) regarding VO₂/kg % (Table 3). In our study, the comparison of oxygen saturation percent (SpO₂ %) between the different groups of cirrhotic patients showed significant difference between groups (A, B), (A, C) and (B, C) regarding SpO₂ % (Table 4).

Discussion

CPET stresses both pulmonary and cardiovascular systems simultaneously so many diseases or conditions that may not be apparent at rest will show overt dysfunction during or after exercise [1]. There is no doubt that gender and height are the most important predictors of lung function. Height linearly correlates with lung size [2].

In our study, comparison of cirrhotic patients and control group regarding pulmonary function test parameters revealed that, there was significant decline in FVC and V_t in the cirrhotic group versus the control group, while there was non significant difference in FEV₁, FEV₁/FVC, PEF, RF between the two groups (Table 1).

Shashikala et al. (2011) studied the effect of long term stress exercises and sports activities on pulmonary function tests in 26 cirrhotic patients and 15 healthy volunteers, FVC, FEV₁, FEV₁/FVC and V_t values were higher in the volunteers, while RF were higher in the cirrhotic patients.⁽¹⁸⁹⁾ qualified by relating specific parameters to oxygen consumption. [3] In this study we found that, the comparison of cirrhotic patients and the control group regarding the cardiopulmonary exercise test parameters revealed that, there was significant difference in VO₂/kg %, METS %, VO₂/HR, Vd/ V_t and SpO₂ % regarding the comparison of cirrhotic patients and the control group, while there was non significant difference in Pet CO₂, Pet O₂, VE/CO₂ and VE/O₂ between the two groups (Table 2).

Many studies have examined the association between cardiopulmonary exercise parameters (VO₂/kg %, METS %, VO₂/HR, Vd/ V_t , Pet CO₂, Pet O₂, VE/CO₂ and VE/O₂) in patients with cirrhosis, and they have found a significant reduction in the exercise capacity and muscle strength of patients with cirrhosis versus healthy controls. These impairments appear to be independent of the etiology of cirrhosis, but the data are equivocal with respect to their association with disease severity [4–6].

Councillet et al. (2004) studied the clinical and physiological effects of a medically supervised, indoor physical training program for 6 months and investigated 26 chronic liver diseased subjects aged 42–55 years. After training there was a significant increase in mean maximal oxygen uptake. These changes were significantly greater in the group undergoing training than in the control group. The subjects motivation, the initial level of fitness, and the symptoms score at the time of training were the most important factors influencing improvements in cardiorespiratory fitness. Thus submaximal physical exercise of controlled intensity, sustained for three months produced significant improvements in fitness and cardiorespiratory performance that should be advantageous to the exercising patients [7]. In this study, the comparison of oxygen uptake per kg ratio

Table 1 Comparison of cirrhotic patients and the control group regarding pulmonary function test parameters.

Variables	Cirrhotic patients	Control group	T test	P-value
FVC	66.32 ± 1.83	69.75 ± 1.62	7.235	0.021*
FEV ₁	71.79 ± 3.51	71.82 ± 1.56	2.141	0.324
FEV ₁ /FVC	80.26 ± 1.42	80.53 ± 1.22	4.651	0.861
PEF	55.92 ± 2.25	55.52 ± 1.38	3.116	0.127
FEF _{25–75%}	76.10 ± 1.92	76.56 ± 1.75	6.821	0.833
RF	27.83 ± 2.05	27.54 ± 1.05	0.2468	0.614
V_t	0.48 ± 0.08	0.93 ± 0.09	4.152	0.042*

* P is significant if 0.05.

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