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ORIGINAL ARTICLE

# Sarcopenic obesity and dyslipidemia response to selective exercise program after liver transplantation

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**KEYWORDS**

Liver transplantation;
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**Abstract** *Background:* As long-term survival improves after liver transplantation, metabolic syndrome, including dyslipidemia, hypertension, diabetes, obesity and sarcopenia is emerging as a major cause of late morbidity and mortality.

*Aim:* The aim of this work was to evaluate the efficacy of exercise training program as a type of physical therapy approach in treatment of sarcopenic obesity and dyslipidemia after liver transplantation.

*Subjects and methods:* Thirty patients with liver transplantation since six months had participated in this study. The patients were randomly divided into two groups of equal numbers. The exercise group received aerobic and resisted exercise in addition to receive the traditional medical intervention. The control group received only the traditional medical intervention. Measurements of fat mass, muscle mass, cholesterol level and triglycerides level (by bioelectrical impedance and lipid profile) were collected before treatment and after three months of treatment.

*Results:* Comparison between exercise and control groups post treatment revealed a significant decrease in fat mass, cholesterol and triglyceride levels in the exercise group compared to the control group ($p < 0.001$), while there was a significant increase in muscle mass in the exercise group compared to control group ($p = 0.0001$).

*Conclusion:* Aerobic and resisted exercise has a positive effect in treatment of sarcopenic obesity and dyslipidemia (reducing fat mass, cholesterol and triglycerides levels while increasing muscle mass) post liver transplantation.



## 1. Introduction

Malnutrition and impaired body composition with loss of total body protein are characteristic findings in patients with end-stage chronic liver disease [1]. Liver transplantation LT is the only therapy that halts the progression of the disease [2].

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Although the survival after transplantation has improved greatly in the last decade, the combination of transplantation with immunosuppressant medication is still associated with several comorbidities, including dyslipidemia, hypertension, diabetes, obesity, osteoporosis, sarcopenia, muscle pain, and metabolic syndrome [2]. Physical function is also limited in patients who underwent a liver transplantation [3,4]and associations between poor prognosis and reduced physical function have been reported [3,5].

Obesity [body mass index (BMI) > 30 $kg/m^2$] develops in 21–43% of patients post-LT. The prevalence of dyslipidemia post-LT ranges from 66% to 85%. An increase in the prevalence of dyslipidemia from 8% before LT to 66% after LT. Elevated cholesterol and hypertriglyceridemia developed in 19% and 59%, respectively [6]. Another study reported an increase in the prevalence of both elevated total cholesterol (2.9% pre-LT versus post-LT 15.3%) and triglycerides (18.2% pre-LT versus post-LT 70%) at 6 months post-transplant [7].

Long-term survivors of liver transplant are not only overweight but exhibit an abnormal body composition characterized by an excess of body fat and obesity and a deficit in skeletal muscle mass, i.e., sarcopenia. This pattern closely resembles that of sarcopenic obesity in cancer or elderly patients [8].

The etiology of dyslipidemia involves many factors, though the immunosuppressive agents are the main triggering factor. Steroids are associated with hyperlipidemia as they stimulate the activity of acetyl-CoA carboxylase and the synthesis of fatty acids, thus raising concentrations of total cholesterol and triglycerides [9]. M-TOR inhibitors increase lipoprotein-lipase activity, increasing the hepatic synthesis of triglycerides [10]. Calcineurin inhibitors reduce the excretion of cholesterol to the bile and the peripheral LDL-cholesterol receptors, thereby raising circulating levels of cholesterol [11].

The link between exercise and improved physical condition has been well established in patients after different types of transplantation [12]. Exercise training can improve exercise capacity, body composition, and muscle strength following different types of transplantation [13–15]. Aerobic exercise promotes beneficial changes in whole-body metabolism and reduces fat mass, while resistance exercise preserves lean (muscle) mass [16]. While resistance training such as weight lifting increases myofibrillar muscle protein synthesis [17], muscle mass and strength [18].

Aerobic exercise increases insulin sensitivity independent of weight loss, inhibits hepatic lipid synthesis and stimulates fatty acid oxidation [19]. Also exercise increases fatty acid oxidation from adipose, intramyocellular, and possibly hepatic sources. Specifically, there is a significant increase during and after exercise in both very low density lipoprotein (VLDL) secretion and VLDL clearance by skeletal muscle, which may accelerate the removal of hepatic triglyceride concentration derived fatty acids. The capacity for VLDL clearance is also known to improve with regular exercise training [20].

## 2. Subjects and methods

Thirty volunteer patients from the El Sahel Teaching Hospital who had liver transplantation since six months were included in the study from February 2013 to September 2014. Their ages ranged from 45 to 55 years. They were examined carefully by the physician before the study procedures. The patients were excluded if they had cancer or were currently being treated for cancer of any origin, neurological or neuromuscular disorders, osteoarthritis or other orthopedic injury, multiorgan transplant recipients, patients used a wheelchair as their primary mode of mobility and any other cardiovascular contraindication to exercise testing and training [21].

### *2.1. Patients*

The patients were randomly assigned into two main groups (A and B). Group A: (exercise group) included 15 patients who received the aerobic and resisted exercises in addition to traditional medical intervention. Group B: (Control group) included 15 patients who had not received any form of physical therapy intervention at any time during the study but this group was instructed and encouraged to remain active and received the traditional medical intervention.

### *2.2. Ethical consideration*

The study protocol was explained in detail for each patient before the initial assessment and signed informed consent was obtained from each patient before enrollment in the study as well as acceptance of the Ethics committee of the University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

### *2.3. Assessment*

Before initiating the treatment program, primary clinical and laboratory investigations were done (liver function tests, renal function tests and blood levels of the antirejection medication) to draw a complete picture of health for all patients and to decide if the patient is able to participate in the study. Each patient was examined medically in order to exclude any abnormal medical problem which was previously mentioned. The patient's name, age, weight and height, were written in the evaluation sheet of every patient. The assessment procedures were conducted before treatment application and at the end of the study after 3 months.

#### *2.3.1. Assessment of BMI for each patient*

Measuring weight and height of each patient by weight and height scale, BMI was calculated according to the following equation: BMI = weight (kg)/height ($m^2$). BMI was calculated before the study only to select the patients who had BMI > 30 $kg/m^2$ according to classification of obesity to participate in the study [22].

#### *2.3.2. Body composition analyses*

Different methods have been developed to measure body composition parameters. We used Bioelectrical Impedance Analysis (BIA), which is an easy, quick, cost-effective and painless test to determine body composition and fluid status and has been widely used in body composition analysis [23,24].

Fat mass and muscle mass were measured by using Bioelectrical Impedance Analysis (beurer BF 100_Body Complete, made in Germany).