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Case Report Open Access

Effects of a Six-Week Daily Undulating Resistance Training Program on Anthropometric Characteristics, Biochemical Profile and Muscular Strength in an HIV-Seropositive Woman with Lipodystrophy: A Case Study

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Abstract

To investigate the effects of daily undulating periodization resistance training (DUPRT) program on anthropometric and biochemical profile and muscular strength in an HIV-infected woman with lipodystrophy. Case report: A 50 year old woman participated in a 6 week DUPRT program. Anthropometric and glycemic profile as well as blood lipid profile pre- and post-DUPRT.

Results: After six weeks, the participant showed increased body lean mass, circumference of arms, thighs and calf, HDL-c, and muscle strength. She also exhibited reduction in fat percentage and fat mass, circumference of neck, chest, waist, abdomen and hip, and levels of fasting glucose, triglyceride, total cholesterol, LDL-c and $HBA1_C$.

Conclusion: Six weeks of DUPRT improved all evaluated profiles in an HIV-infected patient with lipodystrophy.

Keywords: Human immunodeficiency virus; Lipodystrophy syndrome; Resistance exercise; Non-linear training

Introduction

High active antiretroviral therapy (HAART) has modified the pathologic course of human immunodeficiency virus (HIV) infection by delaying virus replication and contributing to improved quality and expectancy of life in people living with HIV [1]. On the other hand, patients undergoing HAART experience side effects such nausea, vomiting, diarrhea, and headaches in the first months of HAART administration [2]. Moreover, long-term use of HAART may favor the development of liver cancer, kidney diseases and neurological disorders [3].

The most deleterious effects of HAART arise from protease inhibitor use [4] and include dyslipidemia, insulin resistance and lipodystrophy [5]. In turn, these alterations contribute to increased cardiovascular disease risk, the second leading cause of death in this population [6]. HIV-associated lipodystrophy syndrome (HIVLS) is characterized by lipoatrophy of the face and limbs and, lipohypertrophy in the abdomen, chest and neck [7]. While there are no defined criteria for the diagnosis of HIVLS, criteria such as patient's report, time of infection, time of HAART, dyslipidemia, low $CD4^+$ cell count and age can be adopted [8].

Concurrent resistance and endurance training has been used successfully to decrease the side effects related to HAART use [9,10]. To the best of our knowledge, there is no clinical trial assessing the effects of daily undulating periodization resistance training (DUPRT) on HIVLS. Thus, the purpose of this study was to evaluate the effects of a 6-week DUPRT protocol on anthropometric, biochemical and immune profiles and muscular strength in a HIV-infected patient with lipodystrophy.

Case Presentation

A 50 year old Latin-American white woman was diagnosed with HIV infection contracted via a heterosexual relationship in 1995 and has received monthly treatment in a university hospital. In 1999, when her $CD4^+$ count reduced to 446 cells/μL, she was started on treatment with lamivudine (3TC) 150 mg and ziduvodina (AZT) 300 mg twice a day. In 2012, efavirenz (EFZ) 600 mg was added once a day. In October 2012, she reported a weight loss of 3.6 kg in two months and was clinically diagnosed with lipodystrophy. At the last medical visit her $CD4^+$ and $CD8^+$ cell counts were 586 and 1280 cells/μL respectively and her viral load remained undetectable.

In September 2014, the patient signed an informed consent form to voluntarily participate in this study after guided ethical information was provided. This study was approved by the local Ethics Committee in Human Research (protocol number 994.745/2015) and registered in Brazilian clinical trials (protocol RBR-4rnq3v).

Procedure

At baseline and after 6 weeks of intervention, anthropometric measures, blood profiles and strength were assessed. All procedures were performed after a 48 h abstention from strenuous exercise and blood samples were collected after a 12 h fast.

Anthropometric assessment

Body mass (BM) and height were measured using a mechanical

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scale and stadiometer, respectively (Filizola®, Campo Grande/MS, Brazil). Body mass index (BMI) was calculated using Quetelet index (BMI=body mass (kg)/height^2 (m)). Circumference measures of the neck, chest, abdomen, hips, arms, thighs and calf were obtained using anthropometric tape (Sanny®, São Bernardo do Campo/SP, Brazil).

A scientific skinfold caliper (Sanny®, São Bernardo do Campo/SP, Brazil) was used to measure skinfolds at seven sites: the chest, triceps, subscapularis, midaxillary, suprailiac, abdominal and thigh. For greater reliability, triplicate measurements of each skinfold were obtained and the mean of the three measures was calculated. Pollock's seven-site skinfold equation was used to calculate body density [11], whereas Siri equation was used to predict body fat percentage (BF%). Florindo equation [12] was used to predict central subcutaneous fat (CSF), peripheral subcutaneous fat (PSF) and total subcutaneous fat (TSF).

Biochemical assessment

Blood samples were collected to asses fasting glucose (FG), glycosylated hemoglobin (HBA_{1C}), triglyceride (TG), total cholesterol (TC), high density lipoprotein (HDL-c) and low density lipoprotein (LDL-c) levels. All procedures were performed in a university hospital and the patient was instructed to fast for 12–14 h and to abstain from alcohol for 72 h. After collection, blood samples were immediately centrifuged at 3500 rpm for 5 min. Biochemical profiles were analyzed by enzymatic colorimetric methods using specific commercially available kits on a CIBA CORNING 550 Express Analyzer® (Bayer, Minnesota, USA).

Muscle strength assessment

The patient was subjected to one repetition maximum (1RM) test [13] for the evaluation of muscle strength in all proposed exercises. Two tests were conducted per day, one for upper limbs and one for lower limbs.

Exercise Program

After a two-week familiarization period, which occurred with 12-15 repetitions (two sets), and load <60% of 1RM, the patient was assessed per a 6 week DUPRT protocol as shown in Table 1.

Results

The patient's anthropometric measures and body composition characteristics are shown in Table 2. The patient's BMI decreased by 2.44% due to the loss of 0.9 kg of body mass. Reduction was observed in the circumference of neck, chest, waist abdomen and hip and increase was observed in the circumference of arms, thighs and calf. Positive changes were observed in her body composition after six weeks of intervention: TSF and CSF levels were reduced by 18 mm whereas PSF was unchanged. Percentage of body fat decreased to 33.95% due to the loss of 2.64 kg of fat. Her lean body mass increased by 1.54 kg.

The patient's biochemical results showed a reduction in FG (14.25%), TG (2.70%), TC (16.72%), LDL (16.72%), and HBA_{1C} (2.99%) and an increase in HDL-c (24.44%) as shown in Table 3.

EXERCISE	MONDAY[A]	WEDNESDAY[B]	FRIDAY[C]
Squat	3 × 4 - 6 RM	3 × 15 – 20 RM	3 × 8 – 12 RM
Bench Press	3 × 4 - 6 RM	3 × 15 – 20 RM	3 × 8 – 12 RM
Hamstring Curl	3 × 4 - 6 RM	3 × 15 – 20 RM	3 × 8 – 12 RM
Pulldown	3 × 4 - 6 RM	3 × 15 – 20 RM	3 × 8 – 12 RM
Calf Sitting	3 × 4 - 6 RM	3 × 15 – 20 RM	3 × 8 – 12 RM
Shoulder Press	3 × 4 - 6 RM	3 × 15 – 20 RM	3 × 8 – 12 RM

RM: Repetition Maximum; [a, b, c]Rest intervals (RI) between sets and exercises [a]RI=3'; [b]RI=45''; [c]RI=1'30''

Table 1: Daily undulating periodization program.

Variable	Pre-test	Post-test	Change	Change (%)
Body mass (kg)	44.60	43.50	-0.9	-2.47
Body mass index (kg/m^2)	20.08	19.59	-0.49	-2.44
Circumference				
Neck (cm)	21	20.5	-0.05	-2.38
Chest (cm)	71	70.5	-0.05	-0.70
Waist (cm)	61	60.5	-0.05	-0.82
Abdomen (cm)	63.5	61.5	-2.0	-3.25
Hip (cm)	71	70	-1.0	-1.43
Right Arm (cm)	13	13.5	+0.05	+3.70
Left Arm (cm)	12.5	13	+0.05	+3.85
Right Thighs (cm)	36	38	+2.0	+5.26
Left Thighs (cm)	35.5	37.5	+2.0	+5.33
Right Calf (cm)	21	22	+1.0	+4.55
Left Calf (cm)	21	22	+1.0	+4.55
Waist-Hip Ratio (cm)	0,85	0,86	+0.01	+1.16
Body Composition				
TSF (mm)	74	56	-18	-24.32
CSF (mm)	60	42	-18	-30
PSF (mm)	14	14	0	0
Fat (%)	21,78	16,26	-5.52	-33.95
Body Fat Mass (kg)	9.71	7.07	-2.64	-37.34
Lean Body Mass (kg)	34.88	36.42	+1.54	+4.23

CM: Centimeters; mm: Millimeters; %: Percentage; kg: kilograms; TSF: Total Subcutaneous Fat; CSF: Central Subcutaneous Fat; PSF: Peripheral Subcutaneous Fat.

Table 2: Anthropometric variables in baseline and after six weeks of NLRT.

Variable	Pre-test	Post-test	Change	Change (%)
Fasting Glucose (mg/dL)	120	102.9	-17.10	-14.25
Triglycerides (mg/dL)	185	180	-5	-2.70
Total Cholesterol (mg/dL)	301.5	251.1	-50.40	-16.72
HDL (mg/dL)	45	56	+11	+24.44
LDL (mg/dL)	219.5	189.6	-29.90	-13.62
$HBA1_c$ (%)	6.02	5.84	-0.18	-2.99

HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; $HBA1_C$: Glycosylated Hemoglobin

Table 3: Biochemical variables in baseline and after six weeks of NLRT.

Strength measures	Pre-test	Post-test	Change	Change (%)
Squat (kg)	30	54	+24	80.0
Bench press (kg)	22	36	+14	63.6
Hamstring curl (kg)	24	40	+16	66.7
Pulldown (kg)	38	55	+17	44.7
Calf sitting (kg)	40	90	+50	125.0
Shoulder press (kg)	18	28	+10	55.6

kg: kilograms

Table 4: Muscle strength at baseline and at the end of six weeks of DUP intervention.

The patient's muscle strength increased in squat (80%), bench press (63.3%), hamstring curl (66.7%), pulldown (44.7%), calf sitting (125%) and shoulder press (55.6%) as shown in Table 4.

Discussion

Our results show that a 6-week DUPRT program is effective in improving body composition, biochemical variables and muscle strength in a woman with HIV-associated lipodystrophy syndrome. Although previous studies have successfully used endurance and concurrent exercise programs [10], to the best of our knowledge, this is the first study to assess DUP in a patient with this disease.

Resistance exercise is the method of choice due to its effectiveness in promoting positive body fat changes (i.e. increase in lean body mass and decrease in fat body mass) [14]. Additionally, resistance training periodization is an important tool to individualize training and to maximize results when compared with non-periodized training [15]. Specifically, DUP yields better results when compared with other periodization approaches, primarily in muscle strength, endurance and increase in lean body mass [16-18].

Although no safe and effective therapy is available for treatment of HIVLS, some studies have shown positive results with growth hormone, testosterone, hypoglycemic therapies or statins [19,20]. Even though such therapies exhibit high efficiency with few side effects, they are not recommended due to their high cost. In contrast, our results show that a 6 week DUP program can be an effective low cost strategy to reduce HAART side effects.

Decreases were observed in the patient's neck (2.3%), chest (0.7%), waist (0.8%), abdomen (3.2%) and hip (1.4%) circumference. HIVLS primarily affects these sites and they are considered cardiovascular risk factors [21]. In addition, a reduction in body fat mass (2.64%) was observed. Increase in fat body mass is associated with higher levels of pro-inflammatory cytokines such as interleukin-1beta, interleukin-6, tumor necrosis factor-alpha and C-reactive protein, which contribute to cardiovascular diseases [22,23]. In addition, we found a reduction in TG (2.7%), TC (16.7%) and LDL (13.6%) and increase in HDL (24.4%) levels. These results are significant since HAART causes dyslipidemia for which statin administration may be required. Thus, in addition to assisting in body aesthetics, DUP may delay the development of cardiometabolic diseases and attenuate the severity of HAART side effects.

Another important finding was the increase in lean body mass (4.23%). HIV-infected patients often experience a loss of skeletal muscle mass, resulting in low aerobic capacity and consequently low physical activity levels [24,25]. The rapid weight loss and muscle wasting contribute to sarcopenia [26]. Moreover, the reduction in FG (14.2%), HBA_{1C} (2.99%) can be explained by the lean body mass increase, because glucose transporter protein (GLUT4) is closely related to the size of the muscle tissue [27].

Raso et al. [28] demonstrated that physically active HIV-positive patients can preserve aerobic capacity, despite not having a controlled routine. However, muscle strength cannot be sustained without a controlled routine. They showed that DUP resistance training presents higher gains in muscle strength, but our results demonstrated strength gain in all indicated exercises, ranging from 44.7% to 125% after a 6 week DUP program, which can contribute to daily life activities.

In conclusion, our present study revealed that DUPRT is an effective, efficient, low cost, non-pharmacological intervention for HIV-associated lipodystrophy. However, these findings can only be applied to this case. Further interventional studies are needed to confirm the effectiveness of DUP on anthropometric characteristics, biochemical profile and muscular strength in HIV-infected patients.

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