Concurrent Exercise Training Restores Heart Rate Variability in Methamphetamine-dependent Individuals

ABSTRACT

Purpose: Heart rate variability (HRV) reflects a healthy autonomic nervous system and is increased with physical training, demonstrating that exercise training can enhance the parasympathetic (vagal) tone and diminished HR. We compared recently abstinent MD individuals with age-matched, drug-free, sedentary male controls (DF) and also investigated whether HRV can be restored with exercise training in the MD individuals.

Methods: 30 subjects (MD=22, DF=22) having heart rate (HR<68) was randomized over 2 days while seated using a monitor affixed to a chest-strap. Previously reported time-domain (SDNN, RMSSD, pNN50) and frequency-domain (LF/HF, NN50) parameters were compared within group during exercise and control conditions 1 day prior to randomization. HRV was compared with standard deviation (SD), root mean square of successive differences (RMSSD), and percentage of 50 ms intervals (pNN50) using Kubios 2.0 software. Baseline and post 8-wk fitness measures included maximal cardiopulmonary exercise test (VO2max), bodyfat % via skinfold caliper, and muscle strength & endurance for leg press (determined as 1-RM and % of 1-RM). To evaluate exercise training effects, we compared two groups: (i) 8 weeks of supervised endurance and resistance training (ME), and (ii) home-based exercise (HC).

RESULTS

Baseline characteristics were matched between groups: age 33±6 years; weight 82.7±12 kg, BMI 27.3±5.2 kg/m2; and duration of methamphetamine use 13.0±4.4 yr. Methamphetamine usage during abuse (x/30 days) was 16.7±5.2 and 1.4±0.7 in ME and HC, respectively. 8-weeks of exercise training yielded a marked increase of HRV with significant (all P<0.001) increases in SDNN (+14.7±2.0 ms, +34%), RMSSD (+19.6±4.2 ms, +63%), LF/HF ratio (+0.3±0.1, +88%), and pNN50 (+2.3±0.3, +60%). Table 1. Mean baseline subject demographics, drug use history and fitness variables between groups.

Table 2. Changes from baseline in fitness variables for the exercise training (ME) and control training (HC) groups.

Table 3. Mean baseline parameters of HRV between groups.

Table 4. Changes from baseline in parameters of HRV for the exercise training (ME) and control training (HC) groups.

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METHODS

• 50 men; 28 meth-dependent (MD) and 22 drug-free (DF)
• All performed baseline HRV measure (with MD also completing post-training as well): subjects were fitted with a physiological monitor affixed to a chest-strap (BioHarness-3™, Zephyr Technologies, Annapolis, MD) for 5-min heart rate.
• Using HRV analysis software (Kubios HRV Software Version 2.0) a cleaned signal was then used to provide normal-to-normal (N-N) intervals in order to compute time and frequency-domain HRV parameters following recommendations of the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology.
• MD randomized to exercise training (ME=n=14) or equal attention without (HC=n=14) throughout.

INTRODUCTION

Heart rate variability (HRV) is recognized as a versatile and promising prognostic marker to detect ANS dysfunction in vulnerable populations. In particular, studies have shown ANS dysfunction, as determined by a highly diminished HRV, among the deleterious health effects of abused substances such as alcohol, sympathomimetics including cocaine and, more recently, methamphetamine.

Methamphetamine dependence (MD) is believed to lead to dopaminergic neurotoxicity and cardiovascular toxicity through the release of excess stored catecholamines, resulting in acceleration of acute and chronic cardiovascular diseases such as coronary artery disease, myocardial infarction, aortic dissection, cardiomyopathy and sudden cardiac death.

Although behavioral approaches have proven moderately successful in treating MD, problems remain with substantial proportions of individuals dropping out early in treatment. Furthermore, many methamphetamine users are unable to sustain gains from treatment and avoid post-treatment relapse. Participation in regular physical exercise may be an effective intervention to aid MD individuals in reducing relapse to drug use. Exercise has proven effective in ameliorating symptoms of depression and anxiety while improving cognition and cognitive deficits found in chronic methamphetamine users. Furthermore, exercise may have a salutary effect on reducing cardiovascular risk factors, such as hypertension and tachycardia, which are associated with methamphetamine use.

While prior research indicates that healthy, acutely-trained individuals exhibit a high degree of HRV compared to sedentary individuals, to our knowledge it is unknown whether ANS dysfunction and diminished HRV can be restored among individuals with MD. Regular exercise transiently stimulates the sympathetic nervous system, but because it strongly augments background vagal activity over time, it may be an effective and practical means to restore a healthy balance of autonomic tone and thereby provide a cardio-protective role.

PURPOSE

To investigate recently abstinent MD individuals in a residential facility and assess: (i) HRV compared with age-matched, drug-free, sedentary male controls (DF), and (ii) HRV before and after 8-weeks supervised endurance and resistance training (ME) compared with those who did not receive training (HC).

REFERENCES

Available upon request