Acute effects of two difference volume of resistance exercises on cardiac hormones, angiotensin-II and lipolysis markers in active young male.

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Abstract

Objective: The natriuretic peptides (NPs) are endogenous cardiac hormones that have been entered in current guidelines for the diagnosis of heart problems. Resistance exercise (RE) has a beneficial effect on the NPs secretion, but there is limited research on what type of volume training of RE is appropriate. Therefore, the purpose of this study was to compare the pro-ANP, NT-pro-BNP, ANG-II, NEFA and Glycerol response during the RE with different volumes.

Methods: Fifteen active men volunteers (age, 26.1 ± 0.9; years; weight, 74.4±1.9 kg; height, 176.3±1.3 cm) after determination of their strength (10-Repetition Maximum) performed two resistance exercise trials with a one-week interval. subjects performed similar resistance protocols while only set frequencies were differing (three-set or five-set for ten movements). Blood samples were taken in three times including, reference point, 3 and 30 minutes after exercise. Data were analysed using two-way repeated measures of ANOVA.

Results: Finding revealed that resistance exercise high-volume has a significant effect on increase NT-pro-BNP (p=0.041) but the increment in ANP and decrement ANG-II was not meaningful. Additionally, lipolysis concentrations as a result of resistance exercise (increased in glycerol and decreased in NEFA) were significant without meaningful between protocols.

Conclusion: Significant augment in NT-pro-BNP due to resistance high-volume (five-set) and synchronized overdrive neuro hormonal with left-ventricular dysfunction demonstrate that resistance exercise high-volume might be related to changes in pressure inside the heart that can contribute to heart problems.

Keywords: Resistance exercise volume, Pro-ANP, NT-pro-BNP, NEFA, Glycerol.

Introduction

The natriuretic peptides (NPs) containing atrial natriuretic peptide (ANP) and brain natriuretic peptide (BNP) which are secreted from cardiomyocytes in response to atrial and ventricular wall stretch, respectively [1]. It is also, a well-known cardiovascular biomarker for early-stage determination in patients with cardiac failure, aortic stenosis, and LV-ventricular dysfunctions [2-4]. Indisputably, NPs secretion involves two fundamental physiological systems, including cardiovascular homeostasis and energy expenditure. Their roles have resulted in reducing blood pressure, cardiac burden, decline renin-angiotensin system and increase renal sodium and water excretion. Lipolysis enhancement is another worthwhile action of NPs, they are associated with increased oxidation of fatty acid in both human fatty tissue and skeletal muscles. Furthermore, specified features of cardiac muscle in uptake free fatty acid are lead to these cardiac hormones contributing to increased plasma levels of non-esterified fatty acid (NEFA) [5]. On the contrary, the renin-angiotensin system is known as the prominent regulator in water and sodium, systemic vasoconstriction, and increased arterial blood pressure. While NPs have been contradicting impact on their functions (counter-regulatory) [6].

Myriads of studies suggest that physical training programs have beneficial effects on the integration of cardiovascular functions, but which of plan training are more efficacy and safety is unexplained. Limiting the physiological interpretations of the cardiac responses to RE high-volume in a normal subject, lead to researchers have been accepting current useful influences of resistance training. However, remedial advantages of RE in patients with heart problems probed meticulously in relation to the standardization of exercise programs [7-9]. But, in individuals who are healthy this subject is infrequent and widely believed that resistance activities are harmless, while it is not without untold damage to the active individuals. Moreover, different kinds of volumes during RE protocols also can be profited for the assessment of inappropriate or abnormal signs and could give us important insights about prediction the threats [7,9]. Moreover, the consequences of increased muscle mass as a result of RE causes a decrease in high-prevalence disease relevant to obesity and multiple metabolic cardiovascular risk factors [10]. To date, the documents indicate that RE is a major component of an exercise program for the refinement of metabolic derangements and preventing metabolic diseases. This data endorsement by the American Diabetes Association [11], American College of Sports Medicine [12] and American Heart Association [9]. Nevertheless, some studies show that cardiac functions associated with intensive RE be to stand on a continuum between normal and pathophysiological [13,14].
Similarly, other research confirmed unfavourable effects of RE on central arterial compliance [15], blood pressure and cardiac afterload pressure during high-intensity RE protocols [16]. The evidence illustrates that prolonged RE program diminished intrinsic cardiovascular risk factors and promoting cardiac functions are remains ambiguously [17-19] whereas, an explanation has not been considering to depict these contradictions.

The other obvious attraction of study was no investigation that examines the alteration of NPs to RE high-volume. In spite of this, RE is an indispensable part of enhancing musculoskeletal aspects and, it is widespread exert in all sports. Therefore, emphasis upon the volume of RE is essential because suggestion based on high-intensity or high-volume might be contributing to some of the on-going cardio-myopathy conditions [20, 21]. Nevertheless, the purpose of the present study is a closer look at this notion, whether RE with high-volume could lead to adverse cardiac effects through fluctuations in pro-ANP, NT-pro-BNP, ANG-II, NEFA, and Glycerol.

Materials and Methods

Approach to the problem

Subjects were allowed to warm-up for 10 minutes with low-intensity treadmill running then performed one repetition maximum (1-RM) for an estimated 10- repetition maximum (10-RM) for eight movements (4 upper and 4 lower body) on the extra session workout. Then, after determining the amount of displaced weight in each item, the subjects performed two different resistance exercise protocols with fluctuation in set frequencies but not exchange in intensity (Table 1). Accordingly, all subjects were performed the 3-set protocol then 5-set protocol by the following the week.

Note. Inter-set rest (45-sec), and Outer-Set rest (180-sec). The means was reported in each protocol based on the maximum weight that each person only performed in 10-repetition, and for each set (three-set or five-set) average was recorded, eventually total mean calculated from averages.

Subjects

Fifteen active physical education male students (age, 26.1 ± 0.1 yrs. BMI, 22.9 ± 1.09 kg·d⁻¹) after filling out a consent form and confirmed health medication participated in this study each of the subjects were a competitive athlete in various fields of university sports. Also, at the time of the implementation of the research project, none of them were in their own training courses.

Procedures

In both exercise sessions, three blood samples were collected. Firstly, prior to the exercise. it has been taken in fasting and after 8 hours of sleep to determine the reference point of the variables. Secondly, 3-minutes after the performance of the resistance exercise because of latency response variables from tissue to the blood. Thirdly and finally, after 30 minutes. In order to follow-up the variables, and probable adjusted responses as a result of their persistence changes or adaptations. Due to the use of statistical cross-design set up, and the pre-test, post-test, and follow-up were run in two separate sessions with a one-week interval accordingly (Figures 1A and 1B).

To measure the amount of cardiac natriuretic peptides and angiotensin-II used Elisa methods, respectively (The pro-ANP plasma levels, ELP kit ANP Pro, Biomedicine, Vienna, Austria. The sensitivity of the method was 0.05 nmol/liter). The percentage of changes in the test within the test was 4.2%. NT-pro-BNP plasma level, pro-BNP NT-ELITE kit, Biomedicine, Vienna, Austria, the sensitivity of the method used was 3 femtomoles per ml, equivalent to 3 picomoles per liter or 3 picomars. The percentage of changes in the test within the test was 3.5%. Ang-II Plasma level, Ang-II Kit, USCN Company, US Department of Commerce. The sensitivity of the method was 3.9 pg/ml. The percentage of changes in the test within the test was 6.7%).

To measure the amount of lipid profile used chemical colorimetric methods respectively (NEFA plasma level, colorimetric kit, AUCC, Germany. The sensitivity of the method was 0.05 mmol/L. The percentage of changes in the test within the test was 1.7% level of triglyceride, TG, Tricyclic glycerol chromatography kit, Pars Tesh Co., Tehran, Iran. The sensitivity of the method was 1 mg / dL. The percentage of changes in the test within the test was 3.2%).

Statistical analysis

The data were analyzed using the Shapiro-Wilk test, Two-way Analysis of Variance, and Bonferroni Post-hoc test at a significant level (P<0.05) via SPSS software. Before comparing the effects of two resistance protocols, resting data (pre-test each week) tested via depended T-test, regarding the reference point of variables. We only observed the difference in the Ang-II at the baseline; therefore we control the effect of resting levels of this variable through evaluation of Analysis of Co-variation (ANCOVA).

Table 1. Resistance exercises.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Intensity/ Repetition × Set (10-RM)</td>
<td>Load (kg)</td>
<td>Intensity/Repetition × Set (10-RM)</td>
<td>Load (kg)</td>
</tr>
<tr>
<td>Flat bench press</td>
<td>80/10 × 3</td>
<td>45.13 ± 7.9</td>
<td>80/10 × 5</td>
<td>39.25 ± 2.31</td>
</tr>
<tr>
<td>Knee extension</td>
<td>80/10 × 3</td>
<td>29.11 ± 3.0</td>
<td>80/10 × 5</td>
<td>21.11 ± 1.89</td>
</tr>
<tr>
<td>Lat-pull down</td>
<td>80/10 × 3</td>
<td>32.10 ± 0.5</td>
<td>80/10 × 5</td>
<td>28.67 ± 2.76</td>
</tr>
<tr>
<td>Lying hamstrings-curl</td>
<td>80/10 × 3</td>
<td>43.38 ± 4.1</td>
<td>80/10 × 5</td>
<td>37.83 ± 3.62</td>
</tr>
<tr>
<td>Biceps preacher curl</td>
<td>80/10 × 3</td>
<td>34.11 ± 7.9</td>
<td>80/10 × 5</td>
<td>30.12 ± 2.19</td>
</tr>
<tr>
<td>Leg- press</td>
<td>80/10 × 3</td>
<td>134.30 ± 7.3</td>
<td>80/10 × 5</td>
<td>107.53 ± 8.1</td>
</tr>
<tr>
<td>Triceps push-down</td>
<td>80/10 × 3</td>
<td>20.45 ± 3.2</td>
<td>80/10 × 5</td>
<td>18.29 ± 1.29</td>
</tr>
<tr>
<td>Squat</td>
<td>80/10 × 3</td>
<td>65.19 ± 7.0</td>
<td>80/10 × 5</td>
<td>56.21 ± 4.92</td>
</tr>
</tbody>
</table>
Results

Shapiro-Wilk test indicated that assumption of normality exist in all of plasma data (P > 0.05), also homogeneity of variances was confirmed by the Leven test. Analyses of variances used to explanation hypothesis of the effects of different volume (three-set × five set) or interaction of resistance exercise significance effects not observed but time effect in each cardiac hormone and lipolysis have demonstrated significant differences (Table 2).

Increase natriuretic peptides concentration during both protocols (Figures 2A and 2B) indicate that cardiac more sensitive to RE. Data analyze of ANP confirmed that volume of RE has not meaningful effects (interaction, p = 0.294, F28,2 = 1.98) but in consideration of time effects (Time, p = 0.001, F28,2 = 20.128) significant value observed. NT-pro-BNP concentration in five-set has a significant increase compare to three-set (interaction, p = 0.041, F28,2 = 8.103). Also in consideration of within group just five-set has meaningful increased (Time, F14,1 = 5.731, p = 0.044).

To examine angiotensin data (Figure 1C) t-test analyze indicate that resting level has significant different (reference points, T28 = 2.413, p = 0.003). Therefore, co-variate analyzed usage to determine real differences impacts of protocols. Then due to elimination effects of resting concentration of angiotensin, data has no meaningful changes due to RE volumes (F28,1 = 0.005 p = 0.943) also in consideration of each time points in both protocols, decreases in angiotensin not reach to significance (within group, F28,2 = 0.205 p = 0.817).

None-esterified fatty acid and glycerol (lipolysis markers, Figure 1C, 1D, 1E) in response to RE volumes have a revers fluctuation. NEFA data due to five set protocols has not a meaningful decrease compare to three-set (interaction, F28,2 = 4.3, p = 0.157) subsequently time effects (F28,2 = 6.77, p = 0.006) was significant (within time point). Glycerol data analyze indicate that volumes of RE has no significant effects (between group, F14,1 = 0.146, p = 0.604) but time effects increase in glycerol was meaningful (within group, F28,2 = 13.976, p = 0.001).

Discussion

In 2019, interest in resistance exercise (RE) plan work out both the recreational and professional varieties- has grown dramatically. In particular, intensive RE programs have been performed widespread among adolescent [22]. The present study demonstrates that RE high-volume associated with significantly increased in the concentration of the N-terminal fragment of brain natriuretic peptide (NT-pro-BNP). Bulk of studies demonstrates that increased in NT-pro-BNP identified as a hallmark for heart attack [23-25] (deeply discussed below). On the other hand, high-volume RE has no significant effect on the increased plasma levels of ANP and decrease angiotensin-II at each time point. Further, lipolysis concentrations (NEFA and Glycerol) in response to both protocols (high-volume, low-volume) altered significantly without differences between protocols.

Most relevance mechanism about increment in plasma ANP due to exercises is increased in the myocardial stretch as a result of raised in blood venue return [26,27]. Albeit, the resistance exercise cause elevated in intrathoracic pressure leading to decrease venous return and cardiac output [28]. The logical explanation for an increase in ANP can be drastically blood venous return during rest periods (reperfusion). recent studies also verified increase release of ANP in response to one session RE in variety populations (healthy, athlete, patient, and elder) [29,30].

Although research on BNP has been considered in pathophysiological conditions extensively than the physiological. Apparently, increases in BNP have determined to compensatory responses to defeat pathophysiological induces [31]. But results in healthy and patient subjects could have been differing meaning. It was providing that risen plasma levels of NT-pro-BNP at the pathophysiological conditions stimulated from intrinsic cardiac risk factors such as to impair excitation-contraction coupling [24,31]. While in physiological conditions increase in BNP occurred through extrinsic factors such as increased End-diastolic volume during exercises and usually not related to maladaptive processes [32]. But cardiovascular exogenous factors can also disrupt physiological conditions at certain times. When the magnitude of volume load on the cardiovascular system will be vigorously. For example, set frequencies and subsequently repetitions are dramatically [33]. Related evidence has focused on whether exhausted protocols which associated with substantially increases in NPs could a reflector of myocardial damage in athletes [25]. Because, evidence revealed that several cases of sudden cardiac death due to cardiovascular problems have been reported in athletes.

Figure 1. Study timeline, same objects get both protocols.

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To the document of exercise-induced myocardial damage, referred to Scharhag et al. [35] work in healthy athletes, twenty young male athletes performed exhausted protocols. Myocardial damage was evaluated by echocardiography and magnetic...
Table 2. Plasma variables measured.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Reference point</th>
<th>Three-set</th>
<th>Five-set</th>
<th>3-min after exercise</th>
<th>Five-set</th>
<th>30-min after exercise</th>
<th>Five-set</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pro-ANP plasma</td>
<td>0.75 ± 0.3</td>
<td>0.79 ± 0.4</td>
<td>1.23 ± 0.7*</td>
<td>1.29 ± 0.7</td>
<td>0.90 ± 0.5</td>
<td>1.05±0.50</td>
<td>0.294</td>
<td></td>
</tr>
<tr>
<td>NT-pro-BNP plasma</td>
<td>6.98 ± 2.6</td>
<td>5.66 ± 2.9</td>
<td>7.1±0.081</td>
<td>6.34±2.4*</td>
<td>7.65±3.6</td>
<td>8.47±1.8</td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td>Angiotensin-II Plasma</td>
<td>28.12 ± 25.2</td>
<td>23.9 ± 18.1</td>
<td>27.76 ± 17</td>
<td>21.17±34</td>
<td>27.33±20</td>
<td>20.93±16</td>
<td>0.072</td>
<td></td>
</tr>
<tr>
<td>NEFA plasma</td>
<td>129.5 ± 30</td>
<td>136.7±30</td>
<td>123.19 ± 20</td>
<td>99.97±28</td>
<td>129.86±28</td>
<td>98.88±26</td>
<td>0.157</td>
<td></td>
</tr>
<tr>
<td>Triglyceride plasma</td>
<td>58.19 ± 13</td>
<td>56.6 ± 10.1</td>
<td>61.11 ± 3.6</td>
<td>62.7±8.1</td>
<td>54.6±7.3</td>
<td>52.9±7.2</td>
<td>0.640</td>
<td></td>
</tr>
</tbody>
</table>

Data expressed as Mean±SD, p-value < 0.05, but only interaction (three-set × five-set) effects reported in final column, while time effects (within sessions, three- set or five-set) was significance differences. Note: *, ≠, δ, €, significant difference versus reference point. ¥, significant difference between reference points. the units of measure for variables were, nmol / L, femto mol / L, Pg / ml, respectively for ANP, BNP, ANG-II and μmol / L for NEFA and Triglyceride.

Practical Applications

NPs are most validity biomarkers among all hemodynamic and intrinsic cardiac factors. Thus, during exercises they are well-established for influencing filling pressure and cardiac capability [23] in responses to stimuli such as augmented cardiac pressure, volume overload and wall tension [41].

Conclusion

In conclusion, high-volume of resistance exercise may contribute to opposite effects on cardiac via elevated blood pressure and increase myocardial works, which it is leading to over secretion of NT-pro-BNP.

References


41. Metra M, Dei Cas L, Bristow MR. The pathophysiology of acute heart failure—it is a lot about fluid accumulation. Am Heart J. 2007;155(1):1-5.
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