THE VASCULAR PROTECTIVE ANSWER OF HDL-CHOLESTEROL DURING AUDITORY STRESS

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Summary

It is widely known that HDL cholesterol is one of the defense mechanisms of the body against the development of cardiovascular disease. Also it is known that noise is one of the major stress factors that may contribute to impaired health of the population. In the present study we tried to find out whether HDL cholesterol may represent the means of defense against the effects of auditory stress by exposing Wistar rats to a noise source, that had an intensity of 45±2 dB in different periods of exposure.

Key words HDL cholesterol, stress, noise, cardiovascular disease, Wistar rats, health

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Introduction

Stress is a normal reaction of people too many and varied sources of noise. The most striking neuroendocrine immune interactions occur in the state of stress. Stress is defined as a dynamic condition in which the normal homeostasis (steady internal environment) is disturbed or threatened.

State of imbalance is induced by stress factors, physical or psychological.

Stress involves primarily mental and behavioral modification components.

Sudden increase central nervous system activity, that control wakefulness, alert mental status, attention, concentration, and the control of autonomic activity of feeding and reproduction is inhibited.

In response to stress, it produce physical changes in circulatory system that redirects nutrients to the activated organs.

A too high or too low reactivity to stress may cause or contribute indirectly to the pathological events. (Catana and Toma, 2007)

Cholesterol arises from two sources:

1. A part is formed in the liver from dietary fat (mostly cholesterol);
2. Some come directly from foods that contain cholesterol

Cholesterol, in order to be transported in the blood, into the liver is related to some carrier proteins. Combination that forms is called lipoproteins. (Hîrsu, et al., 2006)

There are several types of lipoproteins, of which the most important are the lipoproteins HDL, LDL, VLDL.

HDL particles are high-density lipoproteins that carry cholesterol from the tissues to the liver.

From the moment that was proved that HDL can remove cholesterol from arteries and transports it to the liver for excretion, HDL is known as "good cholesterol" and high values represent a low risk of developing coronary heart disease.

Low HDL-Cholesterol is an increased risk for heart disease.

Clinical diagnosis should not be established on a single result, but requires clinical interpretation, accompanied by other laboratory explorations. (Naito, 1984; Young, 2001; Burtis, 1999).
Materials and method

Experimental animals used in our model were albino rats of Wistar line, males aged 14 weeks and weighing 200-220 g.

The animals were bred and maintained in Biobase "Ovidius" University of Constanta, in compliance with the rules of hygiene, food and accommodation required by Community legislation. (Ciudin and Marinescu, 1996)

The experimental model consists of five groups, whose characteristics are:
- Control group (M) - animals in this group were not exposed to noise, serving as a reference for the experimental groups.
- Experimental group (E1) - animals in this group were exposed only once to noise (45 ± 2 dB) for one hour, three minutes exposure, 3 minute break
- Experimental group (E2) - animals in this group were exposed only once to noise (45 ± 2 dB) for 2 hours, 3 minutes exposure, 3 minute break
- Experimental group (E1-7) - animals in this group were exposed to a cycle of exposure to noise (45 ± 2 db) which lasted seven days, for an hour, 3 minutes exposure, 3 minute break.
- Experimental group (E2-7) - animals in this group were exposed to a cycle of exposure to noise (45 ± 2 db) which lasted 7 days, 2 hours, 3 minutes exposure, 3 minute break.

After exposure to sound stress, animals were sacrificed in compliance with the rules of force protection of laboratory animals, and blood samples were collected.

For the determination of triglycerides, blood serum was used, obtained by centrifugation for 30 minutes at 5000 rev / min.

Determination of serum Hdl cholesterol levels was done using the Biochemistry kit marketed by DiaSys Diagnostic Systems GmbH, Germany.

Spectrophotometric method for the determination and the principle of the method is based on a series of biochemical reactions catalyzed by specific enzymes, that finally gives a quinoneimine, whose absorbance can be measured at 524 nm. (Grove, 1979)

Hdl Cholesterol level is expressed in mg / dl. (Tietz, 1995)

Data were processed in the program OriginPro 75.

The level significance was set at p≤ 0.05.

Results

Table 1. Dynamic HDL-cholesterol level after one hour of exposure to noise daily for 7 days, compared with the values obtained after 2 hours of exposure to noise daily for 7 days, expressed in mg / dl

<table>
<thead>
<tr>
<th></th>
<th>HDL-Cholesterol</th>
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<tbody>
<tr>
<td></td>
<td>X±ES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>15,03±1,27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>9</td>
<td></td>
<td></td>
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<tr>
<td>E1-7</td>
<td>17,09±0,75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>4,12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p≤</td>
<td>0,05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>±M%</td>
<td>+13,70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2-7</td>
<td>22,16±1,67</td>
<td></td>
<td></td>
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<tr>
<td>n</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>5,78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p≤</td>
<td>0,05</td>
<td></td>
<td></td>
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<tr>
<td>±M%</td>
<td>+47,43</td>
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Table 2. The dynamics of the level of HDL-cholesterol by a single exposure to noise for one hour, as compared with the values obtained by a single exposure to noise, for 2 hours, in one day, expressed in mg / dl

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<thead>
<tr>
<th></th>
<th>HDL-Cholesterol</th>
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<tbody>
<tr>
<td></td>
<td>X±ES</td>
<td></td>
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<tr>
<td>M</td>
<td>15,03±1,27</td>
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</tr>
<tr>
<td>n</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>19,51±1,75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>8,45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p≤</td>
<td>0,002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>±M%</td>
<td>+29,80</td>
<td></td>
<td></td>
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<tr>
<td>E2</td>
<td>18,80±2,12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>9,23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p≤</td>
<td>0,02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>±M%</td>
<td>+25,08</td>
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Symbols and abbreviations (Snedecor, and Cochran, 1980)
"X ± SE" - standard error;
"N" - number of individual samples that were finally constituted the arithmetic mean,
"t" - the value of "t" test of Student,
"p" - materiality based on the value of "t" (the change was considered significant in terms of statistical value of 'p' ≤ 0.05),
"± M%" - the percentage difference between the batch in question, and controls,
"NS" - change not statistically significant,
"p" ≤ 0.05 - > *

Discussion

![Chart 1](image1.png)

**Chart 1.** The statistical variation of HDL-cholesterol after one hour of exposure to noise daily for 7 days, compared with the values obtained after 2 hours of exposure to noise per day for 7 days.

![Chart 2](image2.png)

**Chart 2.** Statistical variation of HDL cholesterol by a single exposure to noise for one hour, as compared with the values obtained by a single exposure to noise, for 2 hours.

In the present study, test animals were exposed to a noise source with a constant intensity of 45 ± 2 dB, but the length of different time depending on the selected groups.

Sound intensity is located at the threshold of audibility albino rats of Wistar line, which can produce physiological changes.

Brief exposure or a long-term source of noise cause effects on the hypothalamic-pituitary-adrenal axis.

The damage on the axis can cause adverse effects on the body, if the stimulus is maintained.

In this experimental study, we tried to emphasize the possible correlation between exposure to a source of sound stress, and the protection of blood vessels, and the risk of developing heart disease, under the action of auditory stress.

When animals were subjected once for 60 minutes and 120 minutes at a sound intensity of 45 ± 2 db there is a significant increase (p ≤ 0.002 and p ≤ 0.02) of HDL cholesterol levels, with a percentage difference between the batch in question and the control group of +25.08 <29.80 (between group E1 and group E2), (chart 2).

This may represent a possible protective HDL cholesterol action, against the negative effects produced by auditory stress.

If the exposure last longer (7 days), it maintains vascular protection, provided statistically significant levels of HDL-cholesterol (p ≤ 0.05), and a percentage difference between the batch in question and the control group 13.70 <+ 47,43 (between group E1-7 and group E2-7) (chart 1).

This can be explained by the fact that the liver, increases the rate of metabolism of cholesterol.

Fat reserves stored in the muscles of the body, begin to be put into circulation by growth hormone secreted by the pituitary gland, and are carried by lipoproteins to the liver, where it is their conversion into glucose, causing hyperglycemia.

This increase in fat metabolism,
lead to a default level, that remained elevated, of HDL cholesterol, to ensure an effective cardiovascular protection. (Naito, 1984)

The mechanism by which HDL cholesterol fraction is a cardiovascular protective factor is based on facilitating cholesterol efflux of foamy macrophages (foamy cells) from the plaque (when it is present).

Reverse cholesterol transport is provided by HDL-cholesterol, by accepting the fat particles in macrophages, and facilitating their transport to the liver.

By doing so, it ensure the load decreased intimal blood vessels, with cholesterol, and inflammation, caused by macrophages, activated by auditory stress.

Major cholesterol efflux from macrophages, is a protective function of HDL-cholesterol, being closely associated with sharp declines in average intimal thickness of blood vessels, and a low probability of cardiovascular damage, as well as a study conducted by the New England Journal of Medicine shows. (Heinecke, 2011)

Conclusions

1. Exposure to short duration and long duration of a biological system to a noise source can cause pathophysiological manifestations.
2. HDL cholesterol is a protective barrier for the cardiovascular system, which can operate effectively in the face of auditory stress
3. Due to the complex mechanism of action of acoustic stress on the body, there is the risk of cardiovascular disease
4. Due to the mechanism of protection of HDL cholesterol on blood vessels, it is possible to achieve under sound stress, and cardiovascular defense
5. After a single exposure to a sound stress that lasts an hour or 2 hours, there is a statistically significant change in HDL-cholesterol, changes that are present also in prolonged exposure, an hour or 2 hours for 7 days

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