Relationship between Sudden Sensorineural Hearing Loss and Vascular Risk Factors

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Abstract
Objective To explore the relationship between sudden sensorineural hearing loss (SSNHL) and vascular risk factors (including serum lipids and uric acid). Method This is a retrospective analysis of 100 cases of SSNHL seen at the Drum Tower Hospital, Nanjing Medical University, between Jan. 2007 and Apr. 2008. Patient history, blood test results and imaging scans were analyzed. Levels of triglyceride (TG), cholesterol (CHO), high density lipoprotein–cholesterol (HDL–CH), low density lipoprotein–cholesterol (LDL–CH), apolipoprotein AI (ApoAI), apolipoprotein B (ApoB) and uric acid (UA) from these patients were compared with a control group of 56 patients treated for vocal cord polyps or nasal septum deviation during the same period. Patients with hypertension, diabetes, heart, brain, liver or kidney disorders are excluded from the present investigation. Results HDL–CH level was higher and UA level lower in the study group than the control group (P < 0.05). HDL–CH and UA showed no significant differences among different age–groups (P > 0.05). There were no significant differences in the levels of TG, CHO, LDL–CH, ApoAI and ApoB (P > 0.05). Conclusion These data indicate that metabolic disturbances of serum lipids and/or uric acid may be potential risk factors for SSNHL.

Key words Sudden Sensorineural Hearing Loss; Lipid; Uric Acid; Age

Introduction
Sudden sensorineural hearing loss (SSNHL) has been defined as sensorineural hearing loss of 20 dB over at least 3 contiguous audiometric frequencies, occurring within 3 days [1]. Approximately 15,000 new cases of SSNHL occur annually worldwide, accounting for 1% of all cases of sensorineural hearing loss [2,3]. Being a typical acute (mostly unilateral) inner ear disorder with unknown etiology, SSNHL is assumed to be a multi–factorial disorder with different underlying etiologies. At present, SSNHL remains one of the refractory diseases to otologist. Efforts by many experts to find its causes have failed to yield results. Etiologies can be identified in about 10–15% of all cases, including microcirculatory disturbance, infection, autoimmune disorders, but the majority of cases are idiopathic. Microcirculation disturbance in the cochlea as the cause of SSNHL has always been a research hotspot. The deep position of the cochlea within the temporal bone makes it difficult to directly study cochlear microcirculation disturbance or embolism in SSNHL patients. But there seem to be similarities between cochlear microcirculation disturbance and cardio– or cerebrovascular embolism.

In recent years, many studies have been directed to evaluating the role of various cardiovascular risk factors and blood vessel embolism in SSNHL [4,5]. High serum–cholesterol, anticardiolipin antibodies, plasminogen activator inhibitor, blood plasma viscosity, increased fibrinogen, and decreased red blood cell filtration rate have...
been suggested to be associated with SSNHL, although not without controversies\textsuperscript{5,6}. Uric acid, as purine metabolites, can stimulate proliferation of vascular smooth muscle cell and generation of local thromboxane after entering the cell\textsuperscript{8}, with possible effects on the process of cochlear microvascular embolization. The present study is aimed at studying the relationship between SSNHL and vascular risk factors through retrospective case analysis.

1 Material and Methods

1.1 Subjects

1.1.1 SSNHL Group

Subjects were 100 patients seen at the Department of Otolaryngology-Head and Neck surgery, the Affiliated Drum Tower Hospital of Nanjing Medical University between Jan. 2007 and April 2008 with a diagnosis of SSNHL. There were 50 males and 50 females in this group with a mean age of 42.23 years (ranging from 15 to 69 years). Diagnosis of SSNHL was made based upon the criteria established at Jinan Conference\textsuperscript{1}. All cases were unilateral, of which 50 were on right ears and 50 on left. All patients underwent complete audiometric evaluation. Evaluation also included detailed history, physical examination, imaging studies and blood tests. Collected history covered time interval between onset of hearing loss and hospital admission, associated symptoms, emotional disturbances and demographic information including occupation. Body weight was also taken.

1.1.2 Control Group

The control group included 56 patients treated for nasal septum deviation or vocal cord polyps during the same period of time as the SSNHL patients. There were 30 males and 26 females with a mean age of 33 years (ranging from 17 to 60 years). All individuals in this group had normal hearing.

Exclusion criteria included diseases such as hypertension, diabetes mellitus, cardiac or cerebral diseases, liver and kidney diseases, and neoplasm.

1.2 Methods

1.2.1 Blood test indices

Fasting venous blood specimens were sent to the laboratory for testing. Levels of triglyceride (TG), cholesterol (CHO), high density lipoprotein–cholesterol (HDL–CH), low density lipoprotein–cholesterol (LDL–CH), apolipoprotein A1 (ApoA1), apolipoprotein B (ApoB) and uric acid (UA) were tested. Patients were divided into four age groups (≤20, 21–40, 41–60, and >60).

1.2.2 Statistical Analysis

Covariance analysis was conducted using the SPSS10.0 software. Statistical significance was accepted when \( p < 0.05 \).

2 Results

2.1 Subject population

Of the 100 patients, 56% had office jobs, 35% were manual laborers and 9% were in non-specified professions. Events at the onset of SSNHL included fatigue (71.43%), mood changes (84%), and life style changes (16%) such as smoking and drinking. Associated symptoms included vertigo (51%), tinnitus (96%), nausea (34%), and vomiting (24%). The average Body Mass Indexes (BMI) was 22.10 ± 2.38 kg/m\(^2\) in the control group and 22.30 ± 2.27 kg/m\(^2\) in study patients, respectively (\( t = 0.62 \)).

2.2 Serum Lipid and Uric Acid

Table 1 shows results of the tested parameters. Because age distribution was different between SSNHL patients and the control group (\( t = 0.000 \)), age factor was not included in the disease–control comparison analysis. Covariance analysis was used to mitigate the influence of age factor. When compared between the two groups, the differences of HDC–CH and UA levels reached statistical significance (\( p = 0.0010 \) and \( p = 0.0008 \), respectively), and those of the rest indexes did not.

The combined 156 cases were divided into 4 age groups (see methods) and one-factor analysis of variance was used to test influence of age on the indexes. The comparison among the age groups showed no statistically significant differences with HDL–CH, LDL–CH, ApoA1, ApoB and UA (\( p > 0.05 \)), indicating no age effects on lipid or UA metabolism.

3 Discussion

The pathogenesis of SSNHL remains unknown, and is generally believed to be related with virus infection and vascular embolism. There are numerous factors affecting cochlea microcirculation and many studies have focused
on the mechanism of its disturbance recently. However, the studies have been inconclusive. As one of the risk factors for atherosclerosis, hypercholesterolemia contributes to heart/brain/aorta occlusion. Similar effects on the cochlear ischemia–reperfusion injury from hypercholesterolemia have been suspected. Marcucci and his colleagues \[4\] concluded that hypercholesterolemia was an independent risk factor for SSNHL through his study on the relationship between SSNHL and risk factors for cardiovascular and thrombosis. LU Yuan-yuan’s research \[7\] showed that Total CHO, TG, and lipoprotein A in SSNHL group were higher than the control group. Gabriella Cadoni and his colleagues \[9\] were not able to confirm the association between congenital and acquired thrombus risk factors and SSNHL. Likewise, Claudia Rudack and his colleagues \[10\] found no correlation between HDL, CHO, LDL and CHO and SSNHL. Our study shows that total CHO was not different between the SSNHL and control groups, but the HDL–CH level in SSNHL group was lower than the control group. HDL–CH is a type of CHO carried by HDL and indirectly reflects HDL levels. It is well known that HDL drives CHO to counter transport, eliminates extra cholesterol from blood and organs and eventually slows the process of atherosclerosis \[11\]. HDL can also reverse endothelial dysfunction, inhibit LDL oxidation, stimulate endothelial cell proliferation and prostacyclin generation (a vasodilative and anti–thrombosis agent), reduce platelet aggregation \[12\], and much more. Lowered HDL levels diminish these benefits and increase the risk for thrombosis. Improved therapeutic results have been reported when blood lipid adjustment is included in the SSNHL treatment protocol, probably from decreased cochlear ischemia–reperfusion injury \[13\] and blood viscosity \[14,15\].

The higher blood UA level in the SSNHL group than the control group seen in this study suggests a possible relationship between UA and SSNHL. Increased blood UA level may lead to UA deposits in vascular intima, resulting in local damage and inflammation, aggravated arteriosclerosis and accelerated formation of thrombosis \[16\]. However, some researchers insist that UA is the most important antioxidant in blood that can prevent cells from tyrosine residue nitration and prevent extracellular superoxide dismutase from degradation \[17\], thus exerting protective effects in heart and cerebral vascular conditions.

More than 80% of our patients experienced significant mood swings at the onset of SSNHL, similar to reports by Jae-Ho Ban and Yuan-yuan Lu \[6,18\]. Job pressure, emotional and physical stress can lead to anxiety, overexcitation in the nervous system and excessive release of catecholamine, which in turn may result in inner ear vasospasm, increased platelet aggregation and a tendency to thrombosis.

In conclusion, our study indicates a relationship between the occurrence of SSNHL and a number of vascular risk factors including blood lipids and uric acid metabolism disorder. Further studies are needed to investigate pathopoiesis of HDL–C and UA in SSNHL.

**Acknowledgment**

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**References**

<table>
<thead>
<tr>
<th>Item (unit)</th>
<th>SSNHL Group</th>
<th>Control Group</th>
<th>Fvalue</th>
<th>Pvalue</th>
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<tr>
<td>TG (mmol/L)</td>
<td>1.13 ± 0.80</td>
<td>1.39 ± 0.90</td>
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<td>CHO (mmol/L)</td>
<td>4.41 ± 0.98</td>
<td>4.11 ± 1.00</td>
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<td>HDL–CH (mmol/L)</td>
<td>1.12 ± 0.31</td>
<td>1.30 ± 0.29</td>
<td>11.22</td>
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<td>LDL–CH (mmol/L)</td>
<td>2.34 ± 0.73</td>
<td>2.18 ± 0.66</td>
<td>0.26</td>
<td>0.6094</td>
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<tr>
<td>ApoAI (g/L)</td>
<td>1.35 ± 0.32</td>
<td>1.19 ± 0.26</td>
<td>0.48</td>
<td>0.4907</td>
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<tr>
<td>ApoB (g/L)</td>
<td>0.76 ± 0.26</td>
<td>0.76 ± 0.36</td>
<td>0.00</td>
<td>0.9901</td>
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<tr>
<td>UA (umol/L)</td>
<td>332.02 ± 74.96</td>
<td>284.73 ± 91.15</td>
<td>7.24</td>
<td>0.0080</td>
</tr>
</tbody>
</table>

**Table 1 Comparison between the SSNHL and control groups (x±s)**


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