A retrospective analysis of haematologic parameters in patients with bilateral tinnitus

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ABSTRACT

Tinnitus is a perception disorder of sound. In addition to otologic diseases; mood disorders, inflammatory diseases, thromboembolic pathologies may lead to tinnitus. Mean platelet volume (MPV), Platelet Distribution Width (PDW) and Neutrophil-to-Lymphocyte Ratio (NLR) were investigated as biomarkers in tinnitus patients. In this study, we aimed to find whether there is any association between these biomarkers and bilateral tinnitus patients.

Fifty eight with tinnitus and 58 healthy subjects were included to the study. The distribution of age and sex in each group were equal. Hearing thresholds of tinnitus patients were obtained with pure-tone audiometry. Hematologic values were evaluated in each group and correlation between these values and audiometric data were investigated in tinnitus patients.

PDW values of the tinnitus group were found statistically significantly higher than those in control group (p=0.041). NLR was found lower in tinnitus patients and it was statistically significant (p=0.001). MPV values were found similar in each group. In tinnitus group there were no correlation between hematologic values and audiometric data.

In this study, we found blood marker value alterations in bilateral tinnitus patients, but there was no correlation with audiologic data. And so we need larger studies to obtain more significant results.

Key Words: Tinnitus, Mean Platelet Volume, Platelet Distribution Width, Neutrophil to Lymphocyte ratio, Hematologic Biomarker

Introduction

Tinnitus is a symptom which can be mentioned as a perception disorder of sound with no hearing impulse. It is a very common otology complaint that leads to worsening quality of life. There are 2 types of tinnitus: Objective tinnitus and subjective tinnitus. Objective tinnitus can be evaluated with auditory tests, measuring turbulence of blood flow or hearing of extra sounds by a clinician. Subjective tinnitus is the clinical type which the perception of sound is detected by the patient only.

Many aetiological factors can lead to tinnitus like symptoms; cranial trauma, using ototoxic agents, acoustic trauma, sudden sensorineural hearing loss, otosclerosis, presbiacusis and functional disorder of temporomandibular joint (1). Also, vascular diseases can play role in hearing pathologic sounds. Blood flow distortion of inner ear leads to cochlear cell death and impairing their auditory functions easily. It may be shown as tinnitus without hearing loss.

Hematologic samples get importance for predictive analysis for many diseases (2-4). Red blood cell distribution width (RDW) and neutrophil to lymphocyte ratio (NLR) were used for predicting prognosis of Bell Palsy and sudden hearing loss (5-7). Mean platelet volume (MPV), platelet count (PLT) and platelet distribution width (PDW) were found as candidate markers for subjective tinnitus (8-11). The MPV is a value, related to the average size of platelet cells and bigger MPV values may lead more haemostasis (3). PDW is an indicator related to platelet sizes and platelet activation (12).

In this study, we investigated correlation between hematologic values and tinnitus patients and their audiometric data, whether there is an association with inflammatory or thrombotic process.

Materials and Methods

This is a retrospective study. Fifty-eight patients with tinnitus and 58 healthy subjects who referred to the clinic between January 2013 and July 2017 were involved to the study. Twenty-nine of them were female and 29 were male in each group. All data were obtained from the registry system of hospital. Patients were collected according to these criteria: normal ear nose throat examination; having bilateral tinnitus at least since 6 months; without any chronic ear disease such as chronic otitis media, otosclerosis and presbiacusis; without any chronic systemic disease such as diabetes mellitus, hypercholesterolaemia,
Table 1. Demographic parameters of the patients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Patients (n=58)</th>
<th>Control (n=58)</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>38.8 ± 9.41</td>
<td>38.8 ± 9.41</td>
<td></td>
</tr>
<tr>
<td>Sex (Female / Male)</td>
<td>29/ 29</td>
<td>29/ 29</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Value of hematologic blood parameter and statistical analysis (Values are mean ± SD; \( p \) value accepted significant at < 0.05)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Patients (n=58)</th>
<th>Controls (n=58)</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelet count (x103/mm3)</td>
<td>259.4±61.5</td>
<td>248.5±57.0</td>
<td>0.469</td>
</tr>
<tr>
<td>Mean platelet volume (fL)</td>
<td>8.66±1.02</td>
<td>8.34±1.08</td>
<td>0.323</td>
</tr>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>5.14±0.52</td>
<td>5.23±0.46</td>
<td>0.467</td>
</tr>
<tr>
<td>Haematocrit (%)</td>
<td>44.5 ± 5.49</td>
<td>45.2 ± 4.78</td>
<td>0.564</td>
</tr>
<tr>
<td>NLR</td>
<td>1.87 ± 0.51</td>
<td>2.68 ± 1.20</td>
<td>0.001</td>
</tr>
<tr>
<td>Red Cell Distribution Width (%)</td>
<td>14.1 ± 1.34</td>
<td>13.6 ± 1.07</td>
<td>0.104</td>
</tr>
<tr>
<td>Platelet Distribution Width (%)</td>
<td>16.6 ± 0.34</td>
<td>16.2 ± 1.03</td>
<td>0.041</td>
</tr>
</tbody>
</table>

Statistical Analysis: Haemogram count values were evaluated and compared for each group. In study group, blood sample value and audiometric value correlations were evaluated. All results were evaluated as mean±standard deviation. The comparison of continuous variables was performed with independent-samples \( t \) test. The correlation between hematologic parameters and audiometric data were done with Pearson correlation analysis. Categorical variables of the study were compared by chi-square test. The results were considered statistically significant when the \( p \) value was less than 0.05. The data were analyzed using Statistical Package for Social Sciences program version 23.0 (SPSS Inc., Chicago, IL, USA).

Results

There were 29 female and 29 male subjects in each group (Table 1). The mean age was found 38.8±9.4 in two groups (Table1). All values of haemogram were found at normal levels (Table 1). Red blood cell, haemoglobin and haematocrit count were similar for 2 groups and there was no statistical difference (Table 2). Platelet count of tinnitus patients was found higher than those in healthy group, but there was also no statistical difference (Table 2). MPV values of tinnitus patients were higher than healthy subjects, but it was not statistically significant \((p = 0.323)\). PDW was counted higher in tinnitus group and this difference was statistically significant \((p = 0.041)\). Neutrophil to lymphocyte ratio was statistically lower in tinnitus group \((p = .001)\).

The averages of the hearing thresholds were determined in all frequencies (Table 3). The correlation analysis was performed to elucidate...
whether there was any association between MPV, RDW, NLR levels and hearing thresholds of the patients with tinnitus. There was no correlation between MPV, RDW, NLR levels and hearing thresholds at any frequency except for one example ($p > 0.05$). Positive correlation was observed between haemoglobin level and hearing levels at 6000 Hz in tinnitus patients ($r = 0.389; p = 0.028$).

**Discussion**

Tinnitus is an otolaryngologic disorder characterized with perception sound without hearing impulse. It may affect 15% of all population (13). Many aetiologic factors and mechanisms of pathology were hypothesized (14). However, there are not any certain pathophysiological explanations about tinnitus (15-17). This clinical problem can occur at older ages and decrease hearing caused by any ear diseases like otosclerosis, Meniere etc. noise, decreased blood flow or blood vessel occlusion might lead to outer hair cell damage of cochlea (18). In addition, functional disorder of outer hair cell can lead to tinnitus if there is a pathology effecting cochlear homeostasis (14). It was observed that ischemic and inflammatory reactions of cochlear microcirculation may cause tinnitus (18). Also emotional stress disorders can go with subjective tinnitus (19).

Any change in blood cell function, homeostasis or blood flow may lead to cochlear damage easily. In this study we aimed to detect any correlation between blood counts and audiometric results in tinnitus patients. In this study, we found statistical difference between 2 groups about PDW values. Also, NLR was observed lower in the tinnitus group.

As a blood marker MPV shows platelet volume and gives information about platelet function. Highly MPV values were associated with more platelet aggregation and increased risk of ischemic injury (4-20,21). There are many studies on MPV and tinnitus relationship. In two studies, it was evaluated that tinnitus patients had higher MPV levels according to healthy group (8,9). The study with 86 tinnitus patients mentioned that increased MPV levels could be related to increased platelet aggregation and lead to impairment of cochlear blood flow (8). However, no correlation was found between MPV levels and severity of tinnitus (8). On the other hand, a study with 100 tinnitus patients introduced that MPV had been found statistically significant lower in the tinnitus patients` blood samples (10). In this study while tinnitus had negative correlation with MPV, had positive correlation with platelet count and PDW (10). And they mentioned that tinnitus might occur as a result of the inflammatory process. There was no significant difference between healthy subjects and tinnitus patients concerning MPV values in our study with patients of bilateral tinnitus. Similar to our study, MPV values were found higher in tinnitus patients, but the results were not statistically significant in two different studies (11,22).

Platelet distribution width is a marker which measures platelet sizes and increased values are related to increased platelet activation (12). Higher PDW levels were observed in tinnitus group than those in control group, but there was not any correlation between PDW values and hearing levels. Yuksel et al. observed similar to our results about PDW values in tinnitus patients (10).

Neutrophil-to-lymphocyte ratio was investigated in several studies as, predictive or prognostic marker of inflammatory processes, malignancies and cardiac diseases (2-23). It was also studied for otorhinolaryngologic diseases such as Bell Palsy, sudden hearing loss and nasal polyposis (5,7,24). This marker was also studied in tinnitus patients. It was sentenced that tinnitus patients had higher NLR levels and they mentioned that increased NLR could be related to inflammatory diseases and cardiovascular disorders (11). Bayram et al. found no relationship between NLR and tinnitus (22). In our study, NLR had decreased in tinnitus patients when compared to the control group. These different results may be related to the number of patients, unknown systemic pathologies or personal differences.

In our study, there were no correlation between hearing levels and haemogram parameters in tinnitus group. Hearing levels were calculated and average high frequency levels of the patients were revealed. The patients who had levels better than 30 dB was evaluated separately, but there was no correlation between normal hearing levels and blood levels. Platelet contributes to aggregation and it may have different haemostasis potential (8). Yuksel et al. did not find any correlation between hematologic parameters and audiometric data except for platelet count(10). They mentioned negative correlation between platelet count and hearing loss (10).
Tinnitus is a perception disorder of sound without an acoustic impulse from outside. It can have broad spectrum from slight to severe, which can affect quality of life seriously. Many studies had been performed to find a mechanism of tinnitus and to provide certain treatment. Blood sample count studies related to tinnitus were aimed to investigate predictive markers. In our study, we found PDW and NLR have statistically significant relationship with tinnitus patients. In different studies, different markers were investigated as biomarkers and were statistically significant.

We included patients who had bilateral tinnitus to study and the number of subjects was limited. There are contradictory results of different studies and it can be useful to make multicentre large numbered study which will also investigate pathophysiological pathways.

In this study, we found that the increased PDW and the decreased NLR can be related to tinnitus and there was no correlation between hearing levels and haemogram values. These blood parameters may be guide for an etiologic investigation. Also, these parameters are easily available and cost-effective. However, in order to get more accurate information we need more comprehensive studies about the pathophysiology and possible predictive markers.

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**Conflict of interest:** All Authors declared no conflict of interest.

**Ethical approval:** Our study is in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

**References**