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Vertigo and metabolic disorders

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Abstract

Introduction: Metabolic disorders are accepted by many authors as being responsible for balance disorders. Because of the importance of metabolic disorders in the field of labyrinthine dysfunction, we decided to assess the prevalence of carbohydrates, lipids and thyroid hormones disorders in our patients with vestibular diseases. **Material and Method:** The study evaluates the metabolic profile of 325 patients with vertigo who sought the Otolaryngology Department of the University of São Paulo in the Hospital das Clínicas da Universidade de São Paulo. The laboratory tests ordered according to the classical research protocol were: low-density lipoprotein cholesterol fraction, TSH, T3, T4 and fasting blood sugar level. The metabolic disorders found and the ones that were observed in the general population were compared. The high level of low-density lipoprotein cholesterol, the altered levels of thyroid hormones, the higher prevalence of diabetes mellitus were the most significant changes found in the group of study. **Conclusions:** The higher amount of metabolic disorders in patients with vertigo disease reinforces the hypothesis of its influence on the etiopathogenesis of cochleovestibular symptoms.

Keywords: glucose, metabolic diseases, metabolism, vertigo.

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INTRODUCTION

Metabolic disorders are accepted by many authors as being responsible for balance disorders[1]. Metabolic disorders commonly related to labyrinthine dysfunctions are glucose metabolism changes (diabetes, reactive hypoglycemia and hyperinsulinemia)[2-4], thyroid hormones[5], lipid metabolism disorder[6,7] and hormonal changes in women[7].

The first report associating disorders of glucose metabolism and inner ear diseases date back to 1864[8]. The author observed that patients with sensorineural hearing loss had a higher prevalence of diabetes and, then, the link between hearing loss and hyperglycemia was established. Only in 1960 glucose was recognized as one of the main elements responsible for maintaining of the inner ear functional activity[9]. After that, several authors described secondary vestibulocochlear changes due to diabetes mellitus and hyperinsulinemia[3,10,13]. The hair cells and the central vestibular system are sensitive to diabetes mellitus secondary changes. Experimental studies demonstrate that the labyrinth is particularly sensitive to small variations in glucose and insulin plasma. The presence of insulin receptors in the endolymphatic sac[13] and glucose transporters in the stria vascularis[26] strongly suggest that. Not only do lowering thresholds produce otoacousticemission distortion, but reduction of cochlear action potential in electrocochleography can be induced in sheep after hypoglycemia and hyperinsulinemia[33,34]. Disorders of glucose metabolism are considered the most common etiology of metabolic labyrinthine disorders[14,25,36]. Clinically, the Computerized Dynamic Posturography is an useful tool in the objective documentation of the evolution of body balance in patients with glucose metabolism disorders submitted to a glucose restriction diet[35].

Talking about lipid metabolism, the increase of cholesterol blood level (LDL) and triglycerides are reported as etiological agents of labyrinthine disorders[6,15,42]. There is no definitive documentation of the relationship between dyslipidemia and labyrinthine disorders, but the greater prevalence of dyslipidemia in sensorineural deafness patients is documented[43,45]. One theory proposes that insulin and hyperinsulinemia peripheral resistance would be responsible for increasing the production rate of triglycerides[16]. The muscle and liver accumulation of lipids associated with obesity interferes in the production of cytokines and inflammatory pathways activation with consequent insulin resistance[38,40]. Some experimental observations of the inner ear under influence of a diet with high level of lipid showed hair cell lesions, although clinical manifestations are less intense than expected when compared with histological changes degree[6].

Hypothyroidism may be responsible for elevated levels of circulating lipids. Several experimental studies have shown that both peripheral organs and the central vestibular system can be affected by thyroid disorders[5,17]. It is known that role of prestin (responsible protein for outer hair cells contractility) depends on adequate thyroid hormone levels, so sensory hearing loss may be due to thyroid[44]. One prevalence study showed 16% of hypothyroidism in patients with Meniére's disease and only 2% in controls ($p \leq 0.001$)[41].

Because of the importance of metabolic disorders in the field of labyrinthine dysfunction, we decided to assess the prevalence of carbohydrates, lipids and thyroid hormones disorders in our patients with vestibular diseases.

MATERIALS AND METHODS

The study sets up a retrospective section of a population with otoneurologic complaints after approval by the Research Ethics Committee. The files of 325 consecutive patients admitted with dizziness to our neurotology day clinic were evaluated. The study followed all ethical standards prevailing in the Institution.

Routine laboratory tests included the measurement of blood lipids - LDL fraction of cholesterol and triglycerides; thyroid hormones - T3, T4 and TSH; fasting glucose. The three-hour glucose tolerance test (GTT) was performed with patients that had already normal blood glucose, but had already a highly suggestive clinical history of glucose metabolism disorder. Our criteria for GTT application were: clear correlation between the symptoms presented with fasting or postprandial periods, sweet cravings, obesity, diabetes family history.

- The normal parameters for exams were:
- Fasting glucose: 70-110 mg/dl
- LDL: up to 130 mg/dl
- triglycerides up to 200 mg/dL
- T3: 70 to 200 mg/dl; T4: 4,5 to 12 mg/dl; TSH: 0,5 to 4,2 um/ml

The analysis of the three-hour glucose tolerance test was based on KRAFT[18]: blood glucose below 55 mg/dl at any time of the exam; second hour glucose above 145 mg/dl; sum of insulin levels from second and third hours above 75 mg/dl.

In order to evaluate the distribution of frequency for the variables, we used epidemiological population data from the prevalence of these diseases:

- Diabetes Mellitus: 7.6% among people aged 39 to 69 years[19].
- Hypercholesterolemia: 42% among adults[20].
- Hypertriglyceridemia: among 27,6% and 30,4% of population[21].
- Thyroid metabolism disorder: 10% of population[17,21]

Statistical analysis employed the chi-square test and the significance level adopted was 95% ($p < 0.05\%$).

RESULTS

Of the 325 patients evaluated, 238 (73.2%) were female and 87 (26.8%) males. The average age was 50 years.

Thirty-six (11.1%) patients had elevated fasting glucose levels and 289 (88.9%) had normal glucose levels. The diabetes mellitus population prevalence in Brazil is 7.6%[19] and statistical analysis showed a significant difference ($p = 0.012$) Figure 1.

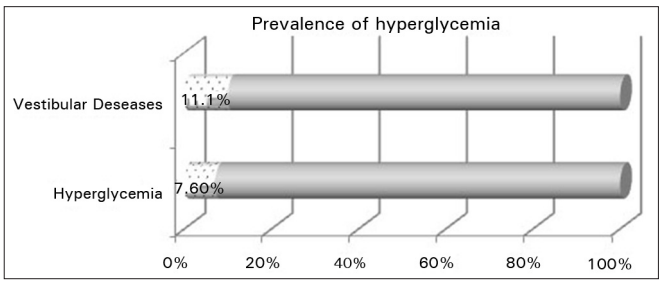

Figure 1. Prevalence of Hyperglycemia.

The glucose tolerance test was positive in 1.2% of all patients with normal blood glucose and suggestive history of carbohydrate metabolic disorder. Therefore, we found changes in carbohydrates metabolism in 12.3% of evaluated cases.

The incidence of thyroid disorders in the population is 10%[17,22]. We found 44 (13.6%) patients with abnormal hormone levels and 281 (86.4%) within normal limits. This shows a significant increase in percentage of affected patients ($p = 0.021$) when compared with the general population Figure 2.

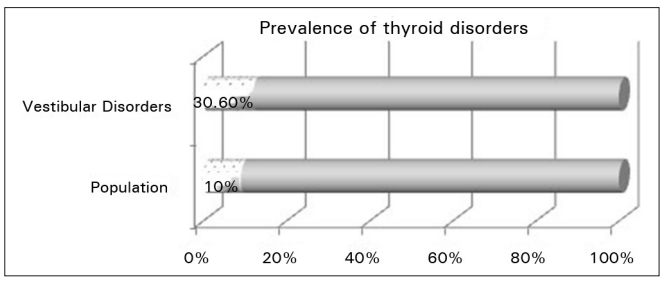

Figure 2. Prevalence of Thyroid Disorders.

Thirty-five (10.8%) patients had elevated TSH and normal T3 and T4 (subclinical hypothyroidism), 2 (0.6%) patients had elevated TSH and decreased circulating T4 (hypothyroidism) and 7 (2.2%) patients showed elevated circulating T4 and decreased TSH levels (hyperthyroidism).

As for lipids, we observed 174 (53.5%) patients with normal LDL and 151 of them (46.5%) showing elevated circulating titles. The high cholesterol level incidence in the general population is 40%[19,20]. Therefore a significant statistic difference in the study group is observed ($p = 0.01$).

Evaluating triglyceride levels, we observed that 290 (89.2%) patients had normal levels and 35 of them (10.8%) elevated levels. The observed number is lower than expected when considering the percentage of the population with elevated rates of circulating triglycerides: between 27.6% and 30.4%[19].

DISCUSSION

Some studies suggest that women are more susceptible than men to otoneurologic changes[23]. This "sensitivity" could be attributed, at least in part, to a natural hormonal variation in women[7]. Our study easily shows this large numerical difference between males and females.

There is plenty scientific evidence of intense metabolic activity in the labyrinthine structures, mainly in the stria[34,35]. The energy used in the form of adenosine triphosphate (ATP) must be constantly supplied by oxygen and glucose. There are no tissue reserves of energy in tge labyrinth and its ongoing activity makes it sensitive to variations of glucose supply during hypoglycemia, or in the presence of high insulin levels[3,25]. Maybe that is one of the reasons why subclinical changes may impact on the labyrinth performance. In diabetes mellitus, the observed changes are microangiopathy and peripheral neuropathy, with consequent terminal blood flow problems and irregular supply of glucose[1,37]. Some authors also reported minimal cellular changes and central vestibular system functional impairment as a complication of early diabetes mellitus, even without neuropathy or microangiopathy[4,11,13]. We found 12.3% of control subjects with abnormal metabolism of carbohydrates, and 11.1% of them with diabetes mellitus. According to the Ministry of Health[19], diabetes affects 7.6% of the population, so our sample has a higher prevalence of diabetes when compared to the general population. These data are consistent with previous patients with tinnitus evaluation, which showed similar rates of diabetes in the study group[24].

Oxygen supply is also required for the Na/K system operation and endocochlear potential maintenance, therefore, blood viscosity variations can compromise terminal flow[6,15]. Besides this effect, the metabolism of lipids is directly associated with that of insulin[27,28,38] and the association between lipid and carbohydrate disorders in patients with vertigo is related to increased risk of atherosclerosis or myocardial infarction[6,15]. There are documented cases of hearing loss, tinnitus and dizziness

related to lipid metabolism disorders, showing recovery of hearing thresholds after hypercholesterolemia and hypertriglyceridemia corrections. These symptoms could be consequent from secondary ischemia due to the increased blood viscosity, reducing the terminal flow[29]. In our sample we could observe a higher percentage of hypercholesterolemia (46.5%) when compared to the general population, which according to the Brazilian Society of Cardiology is 42%. These findings suggest that the higher incidence of high circulating cholesterol levels may be related to vestibular complaints presented by patients in the study group[42]. These data are similar to those observed previously in our patients with tinnitus[2]. It seems that hypertriglyceridemia is not related to labyrinth problems, because the percentage of patients affected in study group (10.8%) is lower than in the general population (between 27.6 and 30.4%)[20].

Studies assessing thyroid dysfunctions and the inner ear are still rare[41]. However, it was experimentally demonstrated that presence of the alpha and beta specific receptors for the thyroid hormone in the ear of mice are essential for its maturation[30]. Moreover, experiments in rats suggest that thyroid hormones are also responsible for the performance of prestin protein directly linked to the outer hair cells activity[44]. It has also been observed that neural stimulus conduction in the central vestibular system is impaired when thyroid hormone is absent[31]. In our patients alterations in thyroid hormone levels reach 13.6% whereas that percentage is 10% in the population[17,22]. This prevalence is similar in patients with tinnitus[2]. The higher thyroid dysfunction prevalence in our sample when compared to the general population suggests that labyrinth functioning depends on adequate thyroid hormone levels. Interestingly, the percentage of subclinical hypothyroidism in the study group assumes the same value that encompasses the total of thyroid disorders in the population (10%), suggesting a peculiar importance of this clinical entity in vestibular disorders.

Exception made to the effect of the glucose tolerance test changes, our findings show similar percentages when compared with a previous study in patients with tinnitus. While the prevalence of curve disorders was 90.3% in the group with tinnitus, the prevalence in the group with dizziness is 1.2%. This can be explained coherently, because the glucose tolerance test was not made immediately in all patients. We believe that, during the follow-up of these patients, this percentage has increased considerably.

Although the human labyrinth may be considered a masterpiece of physiology, its optimal performance can only occur with adequate nutrition and oxygenation. Therefore, its malfunction is considered a key indicator of systemic organic problems.

CONCLUSIONS

The higher prevalence of metabolic abnormalities in patients with dizziness reinforces the hypothesis of its influence on cochleovestibular diseases and routine laboratory tests, including the measurement of blood lipids - LDL fraction of cholesterol and triglycerides; thyroid hormones - T3, T4 and TSH and fasting blood glucose must always be requested.

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