Alcoholism: effects on the cochleo-vestibular apparatus

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Keywords: alcohol.

Summary

Several ototoxic drugs are harmful to the human being and lead to problems such as tinnitus, many types of hearing loss, and vertigo. Alcohol is among the main agents considered ototoxic. Aim: To study the effects of alcoholism in the vestibular-cochlear system. Study Design: cross-sectional contemporary cohort. Materials and Methods: The sample comprehended 37 individuals in the Experimental Group, members of Alcoholics Anonymous of the City Santa Maria-RS, and 37 non-alcoholic individuals in the Control Group, age and gender matching. All of the individuals examined were submitted to anamnesis, otorhinolaryngological examination, basic hearing evaluation, and vector-electronystagmography. Results: 67.57% of the individuals from the Experimental Group showed abnormalities in the audiometry and 24.32% presented abnormalities in the computerized vecto-electronystagmography. In the Control Group, 27.03% of the individuals showed abnormalities in the audiometry and 10.81% presented abnormalities in the computerized vecto-electronystagmography. Conclusion: Alcohol interferes on an individual’s hearing and balance, causing deleterious effects on the human organism.
INTRODUCTION

The vestibular apparatus is an organ with two functions, the cochlea is responsible for hearing and the labyrinth handles balance. Alterations in some of these senses may bring about great difficulties for a human being, such as reduction in the person’s capacity to react to sounds in the environment, reduction in his/her capacity to communicate effectively with the environment, change body balance and generate other problems for the individual.

Dizziness is the major symptom of a balance disorder, that may or may not originate in the vestibular system, and this is only possible to clear up by means of a neurotologic exam. Hearing disorders (dysacusis) and tinnitus may be associated to vertiginous problems1.

Many ototoxic drugs cause harmful effects to the human being, such as tinnitus, different hearing deficits and vertigo. Among the many so called ototoxic agents, alcohol is present2.

Some authors believe alcoholism causes premature aging of neuropsychologic functions and possibly affects the brain as well3.

It is known that drug use, even therapeutically and the exposure to toxic and chemical substances may cause total or partial loss of the vestibular and/or cochlear functions. Among these exogenous substances is alcohol.

Having seen the deleterious effects of balance and hearing disorders on an individual’s life quality, and the impact on his/her social and professional performance, our goal with the present investigation was to study the influences of alcoholism on the vestibulo-cochlear apparatus.

MATERIALS AND METHODS

This is a contemporary cohort cross-sectional study and is registered at the Projects Department at the Health Sciences Center - UFSM under protocol # GAP/CCS 8063.

Following current ethical concepts in research with human beings, only those individuals who freely agreed to participate in this research were accepted; and after they were informed on the project, they freely signed an informed consent form.

This study was carried out at the Otology Ward of the Santa Maria University Hospital (HUSM/ UFSM) in a group of Anonymous Alcoholics of the City of Santa Maria, RS.

The individuals underwent otorhinolaryngological exam, anamnesis, basic audiologic evaluation and vector-electronystagmography.

Otorhinolaryngological exam was performed by an ENT physician, aiming at ruling out any ear, nose or throat disorder.

Anamnesis included issues pertaining to alcoholism such as: when he/she started drinking, type of liquor used, amount consumed, abstinence time, family history, as well as hearing and balance complaints; nausea, vomit, unbalance, sleep disorder, headaches, tinnitus and dizziness.

Basic audiologic tests battery was made up of Tonal Threshold Audiometry (TTA), Speech Recognition Threshold (SRT), Speech Recognition Percentage Index (SRPI) and acoustic immitance measures (AIM) - encompassing compliance (C), tympanometry (T) and Acoustic Reflex Study, both contra and ipsilaterally 4.

Vestibular evaluation was carried out by a Contronic SCV 5.0 Computerized Vector-electronystagmography system. This system carries out vestibulo-oculomotor evaluation by means of a triangular electrode disposition placed near the eyes, which are able to Record corneal-retina potential variations during eye movement. Being basically used to record nystagmus, which is the movement of greatest interest in neurotology.

Of the individuals evaluated, we excluded those who abused of other drugs and also those who had any ear, nose and/or throat disorder.

Thus, according to the criteria adopted for sample selection, the experimental group was made up of 37 individuals who belonged to a group of anonymous alcoholics, broken down in two groups, according to age range:

Experimental Group A (EA): made up of 20 (54.05%) individuals, with ages ranging between 33 and 49 years.

Experimental Group B (EB): made up of 17 (45.95%) individuals, with ages ranging between 50 and 70 years.

Following that we collected individuals who did not abuse alcohol, and had gender and age matching each individual from the study, in order to form the control group (37 individuals) and compared them with the experimental group individuals, also broken down according to age range:

Control Group A (CA): made up of 20 (54.05%) individuals, with ages varying between 33 and 49 years.

Control Group B (CB): made up of 17 (45.95%) individuals, with ages varying between 50 and 70 years.

For analysis purposes, data was collected and distributed for each one of the variables studied in Group A (control and experimental) and in Group B (control and experimental). The statistical study was carried out in a descriptive fashion, with the results attained being organized in tables and presented in absolute and relative numbers.

RESULTS

Table 1 depicts the results attained as to the time of alcohol intake, in years, for individuals from groups EA and EB.
Table 1. Distribution of Groups EA and EB individuals in relation to alcohol intake duration, in years.

| Alcohol intake duration | Group | Minimum | Maximum | Mean |
|-------------------------|-------|---------|---------|------|
|                         | EA    | 5       | 30      | 19.5 |
|                         | EB    | 2       | 50      | 29.95|

Table 2. Distribution of Groups EA and EB individuals in relation to the main complaints presented during anamnesis.

| Group     | EA | %     | EB | %     |
|-----------|----|-------|----|-------|
| Insomnia  | 6  | 30.00 | 9  | 52.94 |
| Stress    | 13 | 65.00 | 14 | 82.35 |
| Headache  | 8  | 40.00 | 10 | 58.82 |
| Irritation| 12 | 60.00 | 13 | 76.47 |
| Sleepiness| 6  | 30.00 | 4  | 23.53 |
| Depression| 12 | 60.00 | 13 | 76.47 |
| Hypertension| 2 | 10.00 | 3  | 17.65 |
| Aggressiveness| 6 | 30.00 | 7  | 41.17 |
| Forgetfulness| 13| 65.00 | 12 | 70.59 |
| Lack of energy| 4 | 20.00 | 11 | 64.70 |
| Lack of attention| 7 | 35.00 | 8  | 47.05 |
| Hearing complaint| 7 | 35.00 | 13 | 76.47 |
| Hypersensibility to sound| 6 | 30.00 | 11 | 64.70 |

Table 3. Distribution of Groups CA and CB individuals in relation to the main complaints presented during anamnesis.

| GROUP     | CA | %     | CB | %     |
|-----------|----|-------|----|-------|
| Insomnia  | 2  | 10.00 | 3  | 17.65 |
| Stress    | 4  | 20.00 | 4  | 23.53 |
| Headache  | 2  | 10.00 | 3  | 17.65 |
| Irritation| 5  | 25.00 | 4  | 23.53 |
| Sleepiness| 1  | 5.00  | 1  | 5.88  |
| Depression| 4  | 20.00 | 5  | 29.41 |
| Hypertension| 0 | 0.00  | 0  | 0.00  |
| Aggressiveness| 0 | 0.00  | 1  | 5.88  |
| Forgetfulness| 5 | 25.00 | 6  | 35.29 |
| Lack of energy| 0 | 0.00  | 5  | 29.41 |
| Lack of attention| 1 | 5.00  | 3  | 17.65 |
| Hearing complaint| 2 | 10.00 | 7  | 41.18 |
| Hypersensibility to sound| 0 | 0.00  | 2  | 11.76 |
Table 4. Distribution of Groups EA and EB individuals in relation to tinnitus.

| Tinnitus | No | %  | Yes | %  |
|----------|----|----|-----|----|
| Group    | N  | %  | N   | %  |
| EA       | 10 | 50.00 | 10 | 50.00 |
| EB       | 7  | 41.18 | 10 | 58.82 |
| Total    | 17 | 45.95 | 20 | 54.05 |

Table 5. Distribution of Groups CA and CB individuals in relation to tinnitus.

| Tinnitus | No | %  | Yes | %  |
|----------|----|----|-----|----|
| Group    | N  | %  | N   | %  |
| CA       | 16 | 80.00 | 4  | 20.00 |
| CB       | 10 | 58.82 | 7  | 41.18 |
| Total    | 26 | 70.27 | 11 | 29.73 |

Table 6. Distribution of Groups EA and EB individuals in relation to dizziness.

| Dizziness | No | %  | Yes | %  |
|------------|----|----|-----|----|
| Group      | N  | %  | N   | %  |
| EA         | 14 | 70.00 | 6  | 30.00 |
| EB         | 9  | 52.94 | 8  | 52.94 |
| Total      | 23 | 62.17 | 14 | 37.83 |

Table 7. Distribution of Groups CA and CB individuals in relation to dizziness.

| Dizziness | No | %  | Yes | %  |
|------------|----|----|-----|----|
| Group      | N  | %  | N   | %  |
| CA         | 18 | 90.00 | 2  | 10.00 |
| CB         | 13 | 76.47 | 4  | 23.53 |
| Total      | 31 | 83.78 | 6  | 16.22 |

Table 8. Distribution of Groups EA and EB individuals in relation to audiometric alterations.

| Audiometry | Normal | Altered |
|------------|--------|---------|
| Group      | N      | %       | N     | %     |
| EA         | 9      | 45.00   | 11    | 55.00 |
| EB         | 3      | 17.65   | 14    | 82.35 |
| Total      | 12     | 32.43   | 25    | 67.57 |

Table 9. Distribution of Groups CA and CB individuals in relation to audiometric alterations.

| Audiometry | Normal | Altered |
|------------|--------|---------|
| Group      | N      | %       | N     | %     |
| CA         | 16     | 80.00   | 4     | 20.00 |
| CB         | 11     | 64.71   | 6     | 35.29 |
| Total      | 27     | 72.97   | 10    | 27.03 |

Table 10. Distribution of Groups EA and EB individuals in relation to VENG alterations.

| VENG       | Normal | Altered |
|------------|--------|---------|
| Group      | N      | %       | N     | %     |
| EA         | 17     | 85.00   | 3     | 15.00 |
| EB         | 11     | 64.70   | 6     | 35.30 |
| Total      | 28     | 75.68   | 9     | 24.32 |

Table 11. Distribution of Groups CA and CB individuals in relation to VENG alterations.

| VENG       | Normal | Altered |
|------------|--------|---------|
| Group      | N      | %       | N     | %     |
| CA         | 19     | 95.00   | 1     | 5.00  |
| CB         | 14     | 82.35   | 3     | 17.65 |
| Total      | 33     | 89.19   | 4     | 10.81 |

Table 12 depicts the distribution of individuals from Groups CA and CB, based on their tinnitus complaint.

Table 6 depicts the distribution of individuals from Groups EA and EB based on their dizziness complaint. If present, they marked “Yes”, if absent, they marked “No”.

Table 7 presents the distribution of individuals from Groups CA and CB, based on dizziness.

Table 8 depicts audiometry results found for individuals from groups EA and EB.

Table 9 depicts the distribution of individuals from groups CA and CB, based on their audiometric results.

Table 10 depicts the results attained for groups EA and EB individuals in computerized vecto-electronystagmography.

Table 11 depicts the distribution of individuals from Groups CA and CB, based on them having or not alterations in computerized vecto-electronystagmography.

Table 12 depicts the results attained in audiometry and computerized vecto-electronystagmography for individuals from groups EA and EB.
DISCUSSION

On Table 1, one can see that the individuals from group EA presented average duration of alcohol intake equal to 19.5 years, and individuals from group EB had 29.45 years. When we compared the two groups, we notice that the individuals from group EB had average alcohol intake duration of 10.45, longer than that of individuals from group EA.

Results related to the complaints presented at the anamnesis by Groups EA and EB individuals are depicted on Table 2. As to the main complaints reported by the individuals from each group, from Group EA we highlight: stress (65%), forgetfulness (65%), irritation (60%) and depression (60%). For group EB, the main complaints were: stress (82.35%), irritation (76.47%), hearing complaint (76.47%), depression (70.59%), lack of energy (64.7%), hypersensibility to sound (64.7%), headache (58.82%) and insomnia (52.94%).

Table 3 depicts the results attained for Groups CA and CB individuals, based on their complaints collected during the anamnesis. For group CA individuals we may highlight: stress (20%), forgetfulness (25%), irritation (25%) and depression (20%). For individuals from the CB group, the main complaints were: stress (23.53%), irritation (23.53%), hearing complaint (41.18%), depression (29.41%), forgetfulness (35.29%) and lack of energy (29.41%).

When we compare the results attained in tables 2 and 3, we see that the complaints collected during anamnesis were present in most individuals from the experimental group, either EA or EB.

Many authors from the literature relate psychological symptoms to alcohol abuse. When he studied patients with psychiatric disorders and that had drank alcoholic beverages for 15 to 20 years, Lima concluded that chronic alcoholism compromises an individual’s mental, physical and social performance. Other authors describe in their studies the occurrence of psychological symptoms because of the abusive consumption of alcoholic beverages.

The results attained in the present investigation are in agreement with those from the aforementioned authors - Table 1 shows that individuals from Group EB had average duration of alcohol consumption above those from individuals belonging to Group EA, in 10.45 years; and thus, shown in Table 2, there was a higher prevalence of all analyzed complaints in individuals from group EB, corroborating the statement that the abuse of alcohol causes not only physical symptoms, such as alterations in different organs and systems, but also psychological symptoms.

Table 4 depicts the tinnitus complaint in individuals from the Experimental Group. In individuals from Group EA, tinnitus was mentioned by 50% (N=10) of the individuals; now, on group EB, 58.82% (N=10) of the individuals complained of it.

On Table 5 it is possible to see the results attained for individuals from Control Groups A and B as far as tinnitus is concerned. Such complaint was present in 20% (N=4) of the individuals from Group CA and in 41.18% (N=7) of those from Group CB.

Comparing Tables 4 and 5, we notice that tinnitus was present in both the Experimental and the Control Groups, with a higher prevalence in those individuals from the Experimental Group, both EA and EB.

When we compare this analysis to what has been published in the literature, we can see an agreement with papers from authors who stated that tinnitus may have numerous causes, such as ototoxic drugs - like alcohol, that may trigger such disorder.

Table 6 depicts the presence of dizziness in the Experimental Group. In individuals from Group EA, dizziness was mentioned by 30% (N=6) of the them; and in Group EB, this complaint was reported by 52.94% (N=8) of the individuals evaluated. When we analyze Table 6, it is possible to see that dizziness was present in both groups; notwithstanding, in Group EB, this complaint was present in more than half of the individuals.

Some studies state that many drugs, alcohol inclu-
ded, cause dizziness as side effect, and thus negatively influence motor skills, including tasks with simple time of reaction, coordination skills, balance and hand-eye coordination. The findings from this study are in agreement with those from the literature studied.

Audiometric results as to the presence or not of hearing alterations, in the experimental group, are depicted on Table 8. We have seen that 55% (N=11) of the individuals from Group EA had hearing impairment, and 82.35% (N=14) of the individuals from Group EB presented this alteration. We may see that in Group EB, most individuals had some hearing loss.

Table 9 depicts the audiometric results found for individuals in the Control Group. For the CA Group, 20% (N=4) of the individuals presented some alteration in this exam. In individuals from group CB, 35.29% (N=6) presented such alteration.

Papers from some authors state that toxic substances such as alcohol cause hearing alterations as side effect, causing degenerative lesion in the hair cells of the Corti Organ. Comparing data from Tables 8 and 9 and data from the literature, we notice that alcoholic individuals have hearing loss, and those that consumed alcohol for longer periods had higher incidences of hearing loss. The findings of the present study corroborate those from the authors we consulted.

When we compare the results attained on Tables 4 and 5, we can see that hearing loss was higher than tinnitus as a complaint, for both EA and EB groups. Authors such as Silva, Munhoz, Ganança & Caovilla reported that most drugs are deleterious for the cochlea, first compromising the base cells, affecting the higher frequencies. Thus, because of such alteration, there is a close relationship between hearing loss and tinnitus, and the latter is an adjuvant symptom in high frequency hearing loss.

Results from the computerized vectoelectronystagmography for groups EA and EB individuals may be seen on Table 10. We noticed that 15% of Group EA individuals (N=3) and 35.3% (N=6) of Group EB individuals had alterations in vectoelectronystagmography. We then stress that such alteration was more evident in Group EB individuals.

Table 11 depicts the results found in the computerized vectoelectronystagmography for Groups CA and CB individuals. It was possible to notice that 5% (N=1) of individuals from Group CA and 17.65% (N=3) from group CB had alterations in the computerized vectoelectronystagmography.

Comparing results from Tables 10 and 11, it is possible to see that the alterations were more evident in the individuals from the Experimental Group, both EA and EB, and the latter had the higher number.

Many authors from the specialized literature reported results similar to the ones found in the present study, mentioning that ototoxic agents, such as alcohol, have a negative impact on the vestibular apparatus, causing vertigo and dizziness.

Table 12 depicts the relationship among results attained in the audiologic evaluation and the results from vectoelectronystagmography (VENG) for both experimental groups: Groups EA and EB. As to Group EA, the individuals obtained the following results: 45% (N=9) of the individuals presented normal hearing and normal VENG result; and 40% (N=8) had altered hearing and normal VENG. As to individuals from the EB group, we have observed that 58.82% (N=10) had altered hearing and normal VENG; and 23.52 (N=4) had alterations in both hearing and VENG.

When we consulted the specialized literature, some authors mention that alcohol is considered an ototoxic agent, have a deleterious effect on the whole body, and it may even cause hearing and vestibular alterations. Authors have reported that alcohol may cause alterations to both the hearing and/or the vestibular systems. According to Silva, Munhoz, Ganança & Caovilla most drugs are deleterious to the cochlea, and less so to the labyrinth. This study agrees with the aforementioned authors, having seen that the results have proven that alcohol first influences the auditory system and later the vestibular system.

**CONCLUSION**

In this investigation it was possible to observe that individuals who abused alcohol had lower results than the individuals in the control group, in all tests applied. Thus, in the present study we can conclude that alcohol intake interferes in hearing and in an individual’s balance, bringing about a deleterious effect to the human body.

**REFERENCES**

1. Mangabeira-Albernaz PL, Ganança MM, Caovilla HH, Ito YI, Novo NF & Juliano Y. Aspectos clínicos e terapêuticos das vertigens. Acta AWHO 1986;5(2):49-109.
2. Russo ICP & Santos TMM. A prática da audiologia clinica. São Paulo: Cortez, 1993.
3. Blusewicz MJ, Dustman RE, Schenkenber GT & Becke C. Neuropsychological correlates of chronic alcoholism and aging. J Nerv Ment Dis 1977;165(5):348-55.
4. Mangabeira-Albernaz P, Mangabeira-Albernaz PL, Mangabeira-Albernaz PP. Otorrinolaringologia Prática. São Paulo: Sarvier, 1981.
5. Ganança MM, Caovilla HH, Munhoz MSL & Silva MLG. Vertigem e Zumbido. XI Curso de Vestibulometria. Rio de Janeiro: 1997.
6. Ganança MM & Caovilla HH. A vertigem e sintomas associados. In: Ganança MM, Vieira RM & Caovilla HH. Princípios de Otoneurologia. São Paulo: Atheneu 1998, pp. 57-61.
7. Ganança FF, Vestibulopatias em Crianças e Adolescentes: Principais Quadros Clínicos In: Ganança MM, Vieira RM & Caovilla HH. Princípios de Otoneurologia. São Paulo: Atheneu 1998, pp. 57-61.
8. Munhoz MSL, Silva MLG, Caovilla HH, Ganança MM & Frazza MM. Vertigem e insuficiência vertebrobasilar: atualidades em geriatria. 1999(4(23):12-5.
9. Fukuda Y. Zumbido e suas correlações otoneurológicas In: Ganança MM. Vertigem Tem Cura? O que aprendemos nestes últimos 30 anos. São Paulo: Lemos 1998 p. 171-176.
10. Ganança MM et al. As tonturas e sintomas associados In: Munhoz MSL, Caovilla HH & Silva MLG. Casos clínicos otoneurológicos típicos e atípicos. São Paulo: Atheneu; 2001, pp. 1-22.
11. Ganança CF, Dias SFG & Ganança MM. Orientação nutricional e mudança de hábitos do paciente vertiginoso In: Ganança MM, Munhoz MSL, Caovilla HH & Silva MLG. Estratégias Terapêuticas em Otoneurologia. São Paulo: Atheneu; 2001, pp. 55-66.
12. Fukuda Y. Tratamento Parte II - Dietas e Medidas Gerais In: Ganança FF. Um Giro Pela Vertigem - Programa de Educação Continuada; Janssen-Cilag; São Paulo; Brasil; 2; 1; 11.
13. Lima JMB. Alcoolismo crônico e atrofia cerebral: problema grave e atual. Rev Bras Neurol 1984;20(4):93-4.
14. Giordani AM. A influência do alcoolismo no equilíbrio postural. Santa Maria 2004. [Dissertação de Mestrado em Distúrbios da Comunicação Humana - Universidade Federal de Santa Maria].
15. Nadvorny N & Nadvorny B. Sinais e sintomas do alcoolismo. Porto Alegre: Acta Médica; 1988, 316-21.
16. Laranjeira R & Jerônimo C. Dependência e uso nocivo do álcool. Unidade de Pesquisa em Alcool e Drogas Departamento de Psiquiatria São Paulo s/d. [http://www.psicosite.com.br/tra/drg/alcoolismo.html#tolerancia].
17. Ramos SP. Alcoolismo hoje. Petrópolis: Vozes; 1997.
18. Campos S. Alcoolismo. 2004. [http://oficina.cienciaviva.pt/~pw020/g/alcool.html]
19. Bento RF, Caetano MHU, Rezende VA, Sanchez TG. Mascaramento do zumbido rebelde ao tratamento clínico. Rev Bras Otorrinolaringol 1995;61(4):290-7.
20. Silva MLG, Munhoz MSL, Ganança MM & Caovilla HH. Ototoxicoses. In: Silva MLG, Munhoz MSL, Ganança MM & Caovilla HH. Quadros Clínicos Otoneurológicos Mais Comuns. São Paulo: Atheneu; 2000, pp. 119-130.
21. Munhoz MSL et al. Conceitos e Algoritmos diagnósticos. In: Munhoz MSL, Caovilla HH & Silva MLG. Condutas na Vertigem. São Paulo: Moreira Júnior; 2004, pp. 55-112.
22. Giron E. Complicaciones neurológicas del alcoholismo. Rev Med Hondur 1984;52(2):119-21.
23. Kendrick ZV, Affrime MB & Lowenthal DT. Effect of ethanol on metabolic responses to treadmill running in well-trained men. J Clin Pharmacol 1993;33:136-9.
24. Guiselin MA. Qualidade de Vida. São Paulo: Balieira; 1996.
25. Campos CAH. Principais Quadros Clínicos no Adulto e no Idoso. In: Ganança MM. Vertigem Tem Cura? São Paulo: Lemos; 1998, pp. 49-57.
26. Rossi AG. Efeitos do Alcoolismo no Processamento Auditivo. São Paulo: 1999. [Tese de Doutorado em Ciências dos Distúrbios da Comunicação Humana - Escola Paulista de Medicina].
27. Ganança MM & Caovilla HH. Como lidar com as tonturas e sintomas associados In: Ganança MM, Munhoz MSL, Caovilla HH & Silva MLG. Estratégias Terapêuticas em Otoneurologia. São Paulo: Atheneu; 2001, pp.1-20.