APPLIED RESEARCH ON TEST ANIMALS (WHITE MICE) EXPOSED TO INDUSTRIAL NOISE

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Keywords:research,white mice,industrial noise

Abstract: *A lot of papers have presented different researches regarding the effects of the noise on the health of workers in weaving mills. These references have pointed out the results of the studies but not pathological or hystological aspects. That´s why it seemed useful to introduce also an applied research on the changes caused by the industrial noise on the receiver organ, more exactly Corti's organ of white mice (exposed to industrial noise).*

Cuvinte cheiecercetari, soareci albe, zgomot industrial

Rezumat: *Multiple lucrări au prezentat diverse cercetări privind efectele zgomotului industrial asupra sănătății lucrătorilor dintr-o țesătorie. Aceste referințe au scos în evidență rezultatele cercetărilor şi nu aspecte de patogenie sau histopatologice. De aceea ni s-a părut util a prezenta şi o cercetare experimentală în domeniul modificărilor produse de zgomotul industrial la nivelul organului de recepție şi anume organul lui Corti, la şoareci albi (expuşi la zgomotul industrial).*

AIM OF THE STUDY

The objective of the experimental research that we are going to present was to study the influence of the noise on Corti's organ of white mice exposed to industrial noise for a various periods of time.

The alteration mark can be revealed by the histological exam of the sensorial auditory cells, an essential part in the spiral Corti's organ.

The exposure to high intensity noise causes hearing loss by affecting the cilia of the auditory cells , which are essential in the mecanical transduction and translation of sound in electrical stimulus. That´s why, in this research, we are going to observe the modification suffered by Corti's organ, after different periods of noise exposure, for a better understanding and explaining the appearance of hearing loss and deafness.

While presenting the experimental results, we shall try to reveal the corelation between the exposure to industrial noise,the exposure period and the appearance of hearing loss and deafness.

MATERIAL AND METHOD

In our research we assumed that after prolonged exposure to industrial noise (with weaving noise characteristics), histopatological changes occur in the receiver organ (Corti's organ).

The second hypothesis which was the basis of our study consisted in the fact that exposure to industrial noise will follow the known evolution of the Corti's organ degradation depending on the period of exposure; the degradation curve undergoes characteristic changes: the longer the exposure, the faster and more pronunced the decline of Corti's organ performance.

The experiments were performed on a research group of 6 pairs of two years old white mice, 6 females and 6 males, and a control group of one pair of white mice. The mice were kept under conditions which complied with the standards imposed by the European Community.

24 months exposure of the 6 pairs of white mice to industrial noise with the characteristics of the weavig mill noise

The experimental part consists in exposing the 6 pairs of white mice, which are kept in separate cages, in a room at constant temperature, inside the biobase of Faculty of Medicine Victor Papilian from Sibiu to industrial noise with the characteristics of the weavig mill noise (85-107 dB) .The source of noise is represented by the weaving mill noise played by a CD through a speaker placed at about 1m from the mice' cages. The daily exposure took place over 7-hours periods, 7 days a week, first week from 7 to 14, the second week from 15 to 22 and the thrid week from 23 to 6, in a 24 months cycle.

Hystopathological exam of the reception organ (Corti ganglion) on the witness lot consisting of 6 pairs of white mice and on the research lot consisting of 6 pairs of white mice after 6, 12, 18 and 24 months from the exposure to the industrial noise with the characteristics of the weaving mill noise

There have been examined **the changes** of Corti's organ of the mice exposed to the industrial noise after 6, 12, 18 and 24 mice compared to the normal Corti's organ of mice which were not exposed to the industrial noise.

The pair of white mice from the control group which was not exposed to the industrial noise was sacrificed at the beginning of the research, in order to perform the hystopathological exam of the Corti organ.

The first pair of white mice was exposed to the industrial noise with the characteristics of the weaving mill noise for 6 months, 7 hours a day, 7 days a week, in three shifts. after 6 months of exposure, a pair of white mice from the study material was sacrificed; their cefalic extremity was disected in the aria of the temporal bone, revealing and performing sections on the internal ear, from which were made mounts for the

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Article recived on 28.05.2010 and accepted for publication 21.09.2010
ACTA MEDICA TRANSILVANICA March 2011; 2(1)165-167

histopathological exam.

The second pair of white mice was sacrified after 12 months of exposure to the industrial noise with the characteristics of the weaving mill noise for 12 months, 7 hours a day, 7 days a week, in three shifts.

The third and the fourth pair of white mice were sacrified after 18 months of exposure to the industrial noise with the characteristics of the weaving mill noise for 18 months, 7 hours a day, 7 days a week, in three shifts.

The last two pair of white mice was sacrified after 24 months of exposure to the industrial noise with the characteristics of the weaving mill noise for 24 months, 7 hours a day, 7 days a week, in three shifts.

The methodology of preparing the histopathological material from the aria of the internal ear

Despite all the undeniable advantages of the smears, detailed, longlasting, structured analisys of some tissues and organs can be made only using the permanent/ conserved microscopic sample. In order to obtain a microscopic sample, the first thing that must be done is to fix it, in other words the supress the vital processes and to conserv the cellular and tissue structures as accurate as posible, with phisical and chemical methods. These samples are included in a liquid but solidifiable mass, that will allow their debiting in thin, transparent sections, by microthomy. The structures obtained from these sections are revealed with technics of colourig and impregnation and fixed between the mount and the slide, in a transparent, well preservative environment.

Realizing permanent mounts requires to perform some successively stages, which are: 1.reaping, 2.fixing, 3.washing and detartration (if needs), 4.inclusion, 5.sectioning, 6.coloration or impregnation, 7.mounting, 8.labelling.

Preparation of the temporal bone of white mice

The internal ear is a real challenge in order to prepare it for microscopy.

It contains organs for the sense of hearing but also for the sense of equilibre.

These organs are surrounded by watery substances (perilymph, endolymph), which are included in the temporal bone making the disection more difficult or even compromiting the mycroscopic sample with artefacts coexisting with the sensorial tissue.

Because the acces to the internal ear is difficult, the most used procedure is to fix the entire ear first of all, then to decalcify the temporal bone and to introduce it in a supportive environment: paraffin, celloidin or plastic, and after that to realise the sections through the entire temporal bone. the temporal bone can also be fixed after fixing it. the exam can be done with or without coloration, thanks to various methods of microscopy. Before sampling the tissue can be permeated with saline to avoid bleeding. Fixative solution shoul be injected into the body of the animal before sectining the temporal bone. The structures of cochlea are studied for histopathological examination at optical microscope.

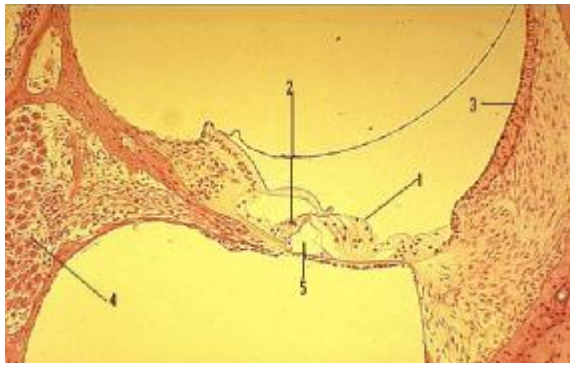
RESULTS

The pair of white mice from the control group unexposed to the industrial noise was sacrificed at the beginning of the research, beeing performed the hystopathological examination of the Corti organ. Coloration: hematoxylin-eosin.[1]

The first pair of white mice was exposed to the industrial noise with the characteristics of the weaving mill noise for 6 months, 7 hours a day, 7 days a week, in three shifts.

After 6 months of exposure, a pair of white mice from the study material was sacrificed; their cefalic extremity was disected in the aria of the temporal bone, revealing and performing sections on the internal ear, from which were made mounts for the histopathological examination.

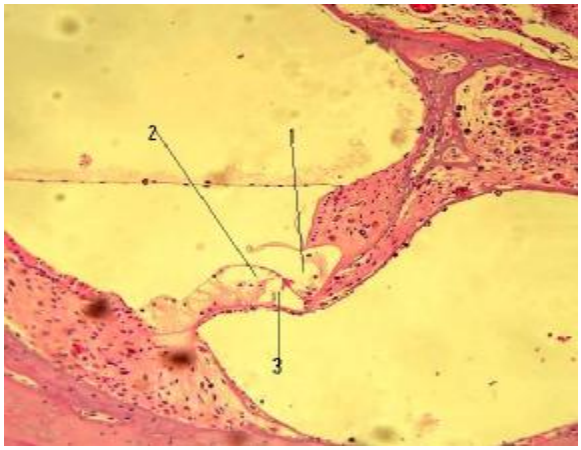
Figure no. 1. Sections in the internal ear with a normal aspect, coloration H.- E., 10x ; 1 – external ciliated cells, 2 – internal ciliated cells, 3 – vascular stria, 4 – Corti's ganglion , 5 – Corti's tunnel



The second pair of white mice was sacrified after 12 months of exposure to the industrial noise with the characteristics of the weaving mill noise for 12 months, 7 hourscells, a day, 7 days a week, in three shifts

At the mice which were sacrificed after 6 and 12 months, the histopathological examination of the internal ear did not revealed changes, comparing to the control group, on the aspect, number of ciliar internal or external cells, on both sides of pillars, striated vascular disposal, membrane tectoria, reissner membrane.

Figure no. 2. Section at the level of the internal ear at 18 months from the exposure at noise, it may be observed the partial destruction of the internal and external ciliated cells of the Corti organ, the modifications of the support cells Deiters and Hensen , modifications of the vascular stria, coloration H.-E., 10x; 1- destroyed internal ciliated cells, 2 – destroyed external ciliated cells, 3 – destroyed pile of the Corti tunnel



The third and the fourth pair were sacrified after 18 months of exposure to the industrial noise with the characteristics of the weaving mill noise for 18 months, 7 hours a day, 7 days a week, in three shifts. [2]

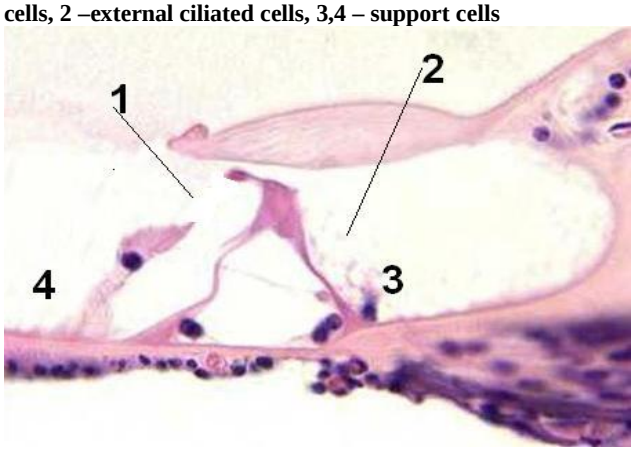
At those mice which were sacrificed after 18 months, the histopathological examination of the internal ear/ Corti's organ revealed partial destruction and structural alteration in the aria of internal and external ciliar cells, changes in the Deiters and hensen supportive cells, and also modifcation of the

vascular streak.

The last two pair of white mice was sacrified after 24 months of exposure to the industrial noise with the characteristics of the weaving mill noise for 24 months, 7 hours a day, 7 days a week, in three shifts.[3] and sever

Histopathological examination revealed severe destruction on the number of ciliar internal or external cells, loss of the supportive cells Deiters and Hensen. The internal cells have been more affected comparing to the external cilliar cells. The cells that were not destroyed presents structural changes. in the same time with the destruction of Corti's organ, the Reissner membrane and membrane tectoria were damaged too. The sensorineural damage of Corti's organ was accompanied by the hyalinisation of spiral ligament and the striatal vascular atrophy

Figure no. 3. Section at the level of the internal ear at 24 months from the noise exposure, it may be observed the approximatelly total destruction of the internal and external celiated cells from the Corti organ, and loss of support cells Deiters and Hensen, coloration H.-E, 40x, 1 –internal ciliated cells, 2 –external ciliated cells, 3,4 – support cells



DISCUSSION

The present study we tried to address a higly issue of great international and national care as a problem of public health, more accurrate the loss of hearing caused by prolonged exposure at industrial noise.

Main objective of this study was to reveal the morphppathological changes in the aria of Corti's organ as an effect of exposure to prolonged industrial noise.

Arguments that led to the elaboration of this study are:

- effects of the industrial noise on the normal function of audiytory analyzer, the Corti organ, ,part of internal ear, which is still a controversial topic in international research. In this context we appealed to the investgation and assesment of pssible effects of noise on Corti organ.
- the insufficient description of the effects that occur in the aria of Corti's organ after prolonged exposure to industrial noise.

The objective of study was to answer to some questions about the risk of irreversible changes in Corti organ after prolonged exposure to industrial noise , but also to bring arguments to sustain this changes.

In order to do this, our research was based on the following considerations:

- we assumed that after prolonged exposure to industrial noise (with weaving noise characteristics), histopatological changes occur in the receiver organ (Corti's organ).
- the hypothesis under which exposure to industrial noise will follow the known evolution of the Corti's organ degradation depending on the period of exposure; the degradation curve undergoes characteristic changes: the longer the exposure, the faster and more pronunced the decline of Corti's organ performance.

Most studies support the correlation between noise exposure and the damage of ciliated internal or external cells followed by hearing loss.

The determination of the severity of changes in Corti's organ was realised by making the histopathological examination of corti organ consisting of sensorial auditory cells. The exposure to high intensity noise causes hearing loss by affecting the cilia of the auditory cells , which are essential in the mecanical transduction and translation of sound in electrical stimulus. Objectify data was realised by observing the modification suffered by Corti's organ, after different periods of noise exposure, for a better understanding and explaining the appearance of hearing loss and deafness.

CONCLUSIONS

Using data obtained in this studyand the data from literature, we tried to bring valuable and useful informations to the healthcare professionals and managers of economic units expose to noise.

This study combines medical research regarding the evaluation of the effects on Corti organ on the time of exposure to industrial noise on animals experience (white mice).

BIBLIOGRAPHY

1. A.C. Guyton, J.E. Hall - Textbook of medical physiology, 11th edition, Elsevier Saunders, 2006
2. Bruce Walmsley, Amy Berntson, Richardson, N. Leao, Robert E. W. Fyffe, Activity-dependent regulation of synaptic strength and neuronal excitability in central auditory pathways, April 15, 2006 The Journal of Physiology, 572, 313-321
3. M.C.Nuțu, I. Ştefan, - "Soluții tehnice pentru diminuarea nivelului de zgomot şi a bolilor profesionale specifice aplicate de către S.C.CET Braşov" Ed. Univ. Petru Maior, Tg. Mureş, 2005