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The effect of working environment on mucous membrane of the upper respiratory tract and organ of hearing in miners of the Lublin Coal Mines

Wpływ środowiska pracy na stan błony śluzowej górnych dróg oddechowych i narządu słuchu u górników Lubelskiego Zagłębia Węglowego

The work in a coal mine takes place in extremely unfavourable conditions that are hazardous to health. A miner is exposed to multi–fractional coal dust and gangue dust, harmful gases e.g. after–damp, noise, improper light. He often works in unusual body position where oxygen is insufficient and microclimate unfavourable, that is high temperature and high humidity, sometimes radiation (7, 8, 10).

Unfavourable working conditions in mining result in increased morbidity affecting especially upper respiratory tract (2, 9, 11). Continuous and pulsating noise as well as vibrations result in the impairment of hearing and balance mechanism (4, 5, 6).

The aim of the study was to evaluate the condition of upper respiratory tract, organ of hearing and balance mechanism in a group of miners employed in the Lublin Coal Mines.

MATERIAL AND METHODS

The study was carried out on a group of 88 miners employed in a coal mine Bogdanka, age from 26 to 46, the average 30.5. In this group 60.2% of miners smoked (53 miners) and 92% drank alcohol occasionally – data obtained from a medical history.

Before employment all the miners underwent otolaryngological examinations by specialists in ENT Teaching Hospital of Medical Academy in Lublin. No abnormalities in the upper respiratory tract or hearing organ or balance mechanism were revealed in any of the miners before employment, so there were no contraindications for working in the coal mine.

Occupational exposure to health hazard in working environment of Lublin Coal Mines ranged within similar time of employment, the average being 10 years 5 months. The miners worked 1,000 m under the ground level, at the air humidity ranging from 71% to 78%, air pollution from 2.0 to 4.7 mg/m^3, noise level from 70 to 110 dB. In this group 64 miners (72.7%) worked directly at obtaining coal, while 24 miners (27.3%) worked also under the ground level, but not directly at mining.

Medical check–up carried out by the ENT occupational surgery at the mine included medical history, otolaryngological and otoneurological history, data analysis from check–ups, and specialist treatment at the time of employment, specialist investigations of the condition of mucous membrane of the upper respiratory tract and the organ of hearing and the balance mechanism. Audiometric examinations, were carried out in sound–attenuating boths using audiometer AAD–80.

The results obtained from audiometric examinations (examination II) were compared with the results in the same miners before the occupational exposure (examination I) (3).

RESULTS

Out of the total number of 88 examined miners 75 (85%) were exposed to noise at the place of work. They were employed directly at mining, preparatory jobs and supporting jobs. 18 miners (20.5%) apart from noise were exposed also to vibrations.

Different diseases of the upper respiratory tract were found in 58 miners (65.9%), and diseases of the organ of hearing and balance mechanism in 12 miners (13.6%). In one of these miners purulent discharge from the middle ear of several years duration was revealed. Minor injuries of facial skeleton without accompanying loss of consciousness was found in 4 miners (4.5%). No ototoxic drugs were taken by the studied miners in the past.

Medical check–up carried out after exposure to the mining working environment revealed rhinitis of various degree of clinical intensity in 42 miners (52.5%), including hypertrophy of nasal concha in 6 miners (6.8%), pathologic discharge from the nose and sinus in 14 miners (15.9%), swelling of nasal concha in 22 miners (25%). A lateral deviation of the nasal septum accompanied by the impairment of its patency was found in 6 miners (6.8%), chronic inflammation of mucous membrane of the pharynx in 39 miners (44,3%), and chronic inflammation of larynx in 6 miners (6.8%).

A physical otologic examination revealed scarring of tympanic membrane of various degree of intensity in 10 miners (11.4%).Unilateral or bilateral retraction of tympanic membrane resulting from rhinitis changes in the middle ear were observed in 15 miners (17%) and in 1 case a chronic inflammatory process in the middle ear.

The impairment of hearing using tone audiometry (charge in the level of threshold curves in the examination II compared with the level of threshold curves in the examination I) was detected in 32 miners (36.4%).

Differences in mean threshold values in the examination I and II for the right ear are presented in Table 1 and illustrated in Figure 1. Differences in mean threshold values in examination I and II for the left ear are presented in Table 2 ind illustrated in Figure 2.

The impairment of hearing took the form of damage to the perceptive apparatus, hypacusis of mixed type, conductive and perceptive, was found only in 2 miners (2.2%) while hypacusis characterized by the damage only to the conductive apparatus was not observed. In the examination in all studied frequencies from 250 to 8000 Hz the impairment of hearing was observed with the mean value ranging from 0.34 to 5.51 dB. The differences were statistically significant. Deterioration of

Table 1. Difference in mean threshold values in the examination I and II. Right ear

Frequency (Hz)	250	500	1000	2000	3000	4000	6000	8000
Difference in mean values	-1.08	-0.91	-0.74	-0.74	-1.53	-5.51	-3.35	-4.77

Table 2. Difference in mean threshold values in the examination I and II. Left ear

Frequency (Hz)	250	500	1000	2000	3000	4000	6000	8000
Difference in mean values	-0.34	-0.85	-0.91	-1.70	-1.76	-4.55	-3.98	-3.75

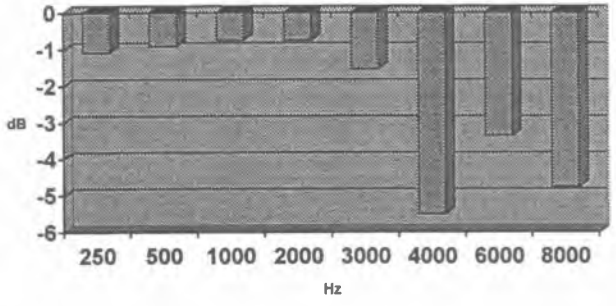

Fig. 1. Difference in mean threshold values in the examination I and II. Right ear

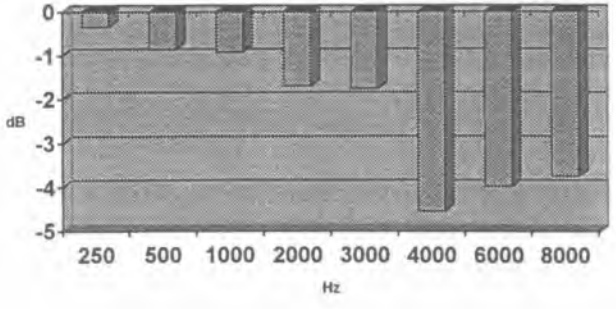

Fig. 2. Difference in mean threshold values in the examination I and II. Left ear

hearing in the investigated group was observed more often in high frequency range (4000 to 8000 Hz) than in low frequency range (250 to 3000 Hz), and the difference in mean values between the examination I and II was the greatest for the frequency 4000 Hz.

DISCUSSION

Medical history taken from 88 miners revealed that 58 miners (55.9%) suffered from various diseases of the upper respiratory tract, 12 miners (13.6%) suffered from the diseases of the organ of hearing and balance mechanism including 1 miner with purulent discharge from the middle ear. The physical examination revealed pathologic condition of the mucous membrane of the nose and paranasal sinus in 46 (52.5%), pharynx in 39 miners (44.3%) and larynx in 6 miners (6.6%). After the analysis of the diseases of paranasal sinus among miners Jezierski (2) found that the inflammation of paranasal sinus is one of the common diseases among miners. Zemła et al. (10, 11) proved significantly higher risk of laryngeal cancer among coal miners exposed to the effect of various kinds of pollution with dust and gas. Semczuk et al. found still higher percentage of diseases of mucous membrane of nose, pharynx and larynx among miners from Lublin Coal Mines as compared with the above mentioned results (5). Zawisza et al. (9) investigated a group of coal miners suffering from the inflammation of the upper respiratory tract for allergy and found out 7% of allergic background in these diseases presenting sensitization to industrial allergens.

The impairment of hearing among miners of the coal mines was found using both measurements of tone audiometry and also using otoacoustic emission or by measuring temporal hearing loss that was confirmed in numerous current papers (1, 4, 5, 6).

In our study the increase in the hearing threshold, confirmed by audiometric examination, was found in 32 miners (36.4%). It seemed to be the damage to the perceptive apparatus, while the hypacusis conductive and perceptive in character was observed only in 2 miners (2.2%).There was the impairment of hearing at all investigated frequencies from 250 to 8000 Hz, the value of which was not really high, but because of the great number of miners affected it appeared statistically significant. The impairment of hearing in the investigated group occurred more often within high frequency (4000 to 8000 Hz) than within low frequency (250 to 3000 Hz).

After analyzing the results obtained from medical check–up in the investigate group of miners examined after occupational exposure – the average being 10 years – it may be assumed that the increase in inflammatory diseases of the upper respiratory tract may be associated with the negative exposure to some unfavourable factors found in the working environment of the miner, that is humidity and air pollution, and also noise level, the intensity of which exceeded the individual resistance of natural defence mechanism of the middle ear in some miners in the investigated period.

CONCLUSIONS

1. Unfavourable working conditions seem to influence the condition of the mucous membrane of the upper respiratory tract and organ of hearing in miners from the Lublin Coal Mines.

2. In the investigated group of miners the impairment of hearing was observed at all analysed frequencies ranging from 250 to 8000 Hz as compared with the

examination I. The mean value of the impairment ranged from 0.34 to 5.51, which is statistically significant.

3. The impairment of hearing in the investigated group was observed more often in high frequencies (4000 to 8000 Hz) than in low frequencies (250 to 3000 Hz).

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STRESZCZENIE

Celem przeprowadzonych badań była ocena stanu błony śluzowej górnych dróg oddechowych oraz narządu słuchu i równowagi w grupie górników Lubelskiego Zagłębia Węglowego.

Grupę badaną stanowiło 88 górników pracujących w kopalni węgla kamiennego „Bogdanka" – średnia wieku 30,5 lat. Wszyscy górnicy przed podjęciem pracy w kopalni przeszli wstępne specjalistyczne badania otolaryngologiczne w Klinice Lubelskiej. Czasokres negatywnej ekspozycji zawodowej – oddziaływania środowiska pracy w postaci hałasu, zapylenia i swoistego mikroklimatu wyrobiska o głębokości średniej 1000 m pod ziemią – w warunkach Lubelskiego Zagłębia Węglowego wahał się w niewielkim przedziale czasu, średnia dla całej grupy badanej wynosiła 10 lat i 5 mies.

W badaniach kontrolnych po wymienionym okresie ekspozycji górniczego środowiska pracy u 52,5% badanych (46 osób) stwierdzono stany nieżytowe błony śluzowej nosa o różnym stopniu klinicznego nasilenia, przewlekły nieżytowy stan zapalny błony śluzowej gardła u 44,3% górników – 39 osób, a przewlekły nieżyt krtani u 6,8% badanych – 6 osób. Pogorszenie stanu słuchu w grupie badanej w okresie obserwacji stwierdzono u 32 osób (36,4%) i występowało ono znacznie częściej w zakresie częstotliwości wysokich (4000 – 8000 Hz) niż niższych (250 – 3000 Hz).