



A STUDY OF BIOMARKERS AND HEALTH STATUS IN MINING INDUSTRY WORKERS WHO USE TCE ADHESIVES

M. Platikanova^{1*}, J. Racheva², A. Zheleva³, B. Grigorov³, V. Gadjeva³

¹ Professional Diseases Section, Department of Hygiene, Microbiology, Infectious Diseases and Epidemiology, Faculty of Medicine, Trakia University, Stara Zagora, Bulgaria

² Occupational Health Service "Maritsa East" EAD, Bulgaria

³ Department of Chemistry and Biochemistry", Faculty of Medicine, Trakia University, Stara Zagora, Bulgaria

ABSTRACT

The study covers 90 machine operators of rubber conveyor belts in "Trojanovo 1" mine, "Trojanovo North" mine controlled by Mini Maritsa Iztok EAD. Most harming for them is the trichloroethylene (TCE) present in the adhesives "Тип Топ цемент SC 200" and "Тигростик СЦ – 022" that they work with. This is a study that includes an anamnestic, physical and clinic-laboratory examination. Diseases affecting the blood circulation organs and the bone-muscular system, eye diseases and diseases of the respiratory, digestive and neural systems are predominant in the sick rate structure. A biochemical finding testifies to enzyme aberrations (increased AST and ALAT activity) in 17.77% of the study subjects. TCA in urine is above the norm in 8.89% of the cases whereas the Trichloroethanol- in 15.56% of the examined workers. In 4 of the workers aberrations in more than 2 of the abovementioned factors have been identified.

Key words: Trichloroethylene, trichloroacetic acid, trichloroethanol, machine operator, vulcanisation, rubber conveyor belts

Machine operator specialised in vulcanisation of rubber products – rubber conveyor belts – is one of the basic professions in the mining industry. The operator cuts out the ends of the rubber belts and applies the necessary adhesive onto the rubber parts with the help of a brush or a putty-knife. Proper adhesion requires the absence of air between the parts, so the machine operator presses the parts with the help of special rollers applied during the vulcanisation. The main ingredient of the adhesives „Тип Топ цемент SC 200" and „Тигростик СЦ – 022" that these workers use is trichloroethylene (TCE).

In production conditions, TCE enters the body through inhalation or dermal contact. It is absorbed mainly in the liver and is eliminated without modification together

with the exhale air or via metabolic transformation into two main metabolites, namely trichloroethanol and trichloroacetic acid, which are discharged with the urine (2, 3).

The objective of the current study is to gather information about the health of workers using TCE adhesives in Mini Martisa Iztok EAD through examining the changes in exposition and effect of some biomarkers, by recording the effect of specific production factors (toxic substances – TCE), the duration of the workers' employment history and by assessing their health status.

MATERIALS AND METHODS

The subject of the study is 90 machine operators of rubber conveyor belts in "Trojanovo 1" mine and "Trojanovo North" mine, controlled by Mini Maritsa Iztok EAD.

The set of methods used for examination and diagnostics includes: specially prepared questionnaire including ID data, employment history, past diseases, current complaints

*Correspondence to: Magdalena

Platikanova, Faculty of Medicine, Trakia University, Stara Zagora, Professional Diseases Section, Department of Hygiene, Microbiology, Infectious Diseases and Epidemiology

concerning different organs and systems, full physical condition, measuring the arterial pressure, determining the serum activity of transaminases: Aspartate aminotransferase (AST) and Alanine aminotransferase (ALAT) used for biochemical testing of the liver, determining the TCA and TCE in the urine.

All results have been statistically processed using the method for data grouping and alternative analysis.

RESULTS AND DISCUSSION

The studied workers are men aged from 20 to 60 years. The distribution by age can be found in **figure 1**. The biggest group is age 36-45 which makes up 35.56%. The relative share of the groups 26-35 and 46-55 is approximately the same, 28.88 and 26.67 respectively. The number of workers below 25 or above 55 years is small – 5.56% and 3.33%, respectively.

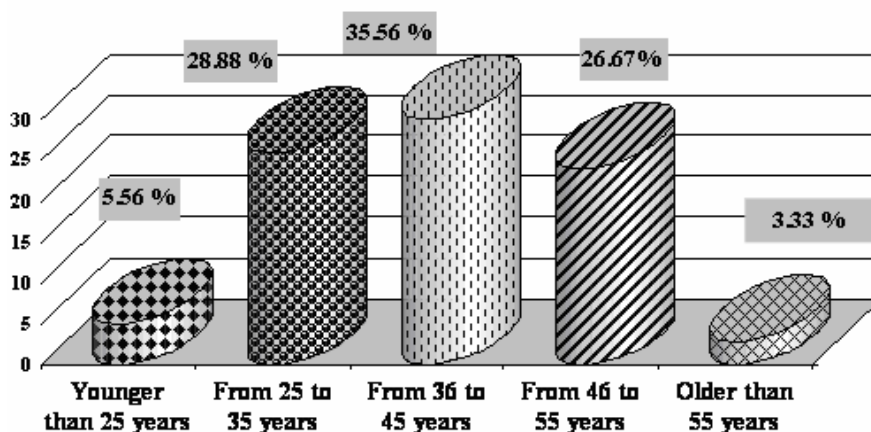


Figure 1. DISTRIBUTION OF STUDIED WORKERS BY AGE

The diagram on **figure 2** shows the distribution of the study subjects by employment history. More than half of the workers have an employment history of more than 10 years (54.44%),

followed by workers with employment history of less than 3 years (28.89%). The relative share of study subjects with employment history from 3 to 10 years is 16.67%.

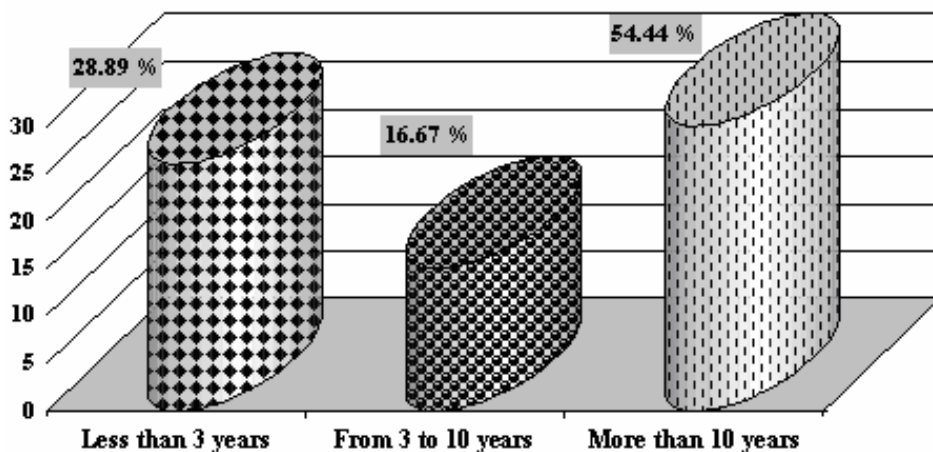


Figure 2. DISTRIBUTION OF STUDY SUBJECTS BY EMPLOYMENT HISTORY

Depending on the meteorological conditions, the vulcanisation takes place in a tent where the measured average TCE concentrations per shift are above the sanitary and hygienic conditions. In case of long-term use of TCE products,

the adhesive and its metabolites are found in different organs and tissues. There are different current scientific data on the effects on the respiratory system, as well as on the hepatotoxic, neurotoxic, nephrotoxic and cancerogenous potential of TCE (4, 5).

The analysis of the data from anamnesis, examination and paraclinical examination of each worker has established that 74.44% of the subjects are clinically healthy. Amongst the remaining workers,

diseases affecting the blood circulation organs and the bone-muscular system, eye diseases and diseases of the respiratory, digestive and neural systems are predominant (**figure 3**).

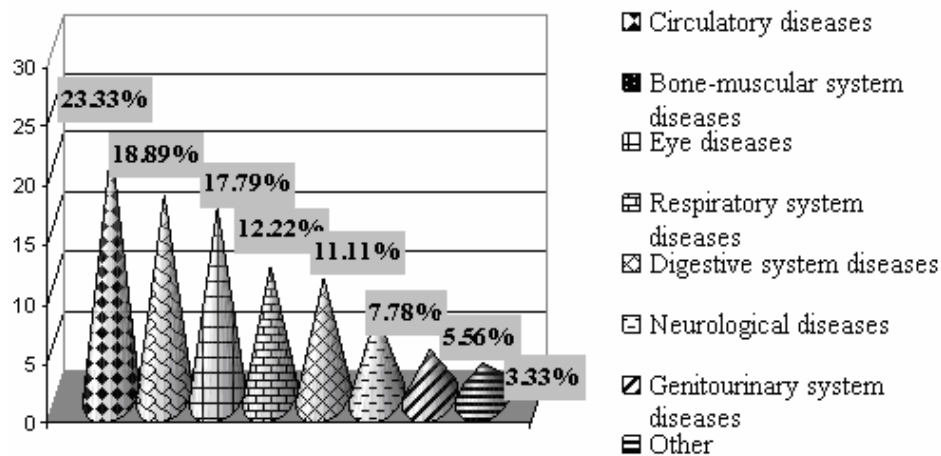


Figure 3. RELATIVE SHARE OF DIAGNOSED DISEASES BY SYSTEM

The ethiopathogenesis of these diseases is complex and is contingent upon various factors each of which has different significance in each specific case. The work environment factors in the case of the toxic substance, TCE, can contribute to but not be the reason for their emerging (1).

Anamnesis data show a high relative share of workers complaining about the cardiovascular system (CVS): Palpitation – 23.33% and sometimes sharp pain in the heart region – 8.89%. 18.89% report pain in the bones and muscles during work. Burning sensation in the eyes is found in 17.79% whereas 12.22% of the workers experience irritation in the nose and throat. 22.22% complain about digestive tract discomfort – acid dyspepsia – sometimes stomach ache – 21.11, nausea - 11.11%, burning - 4.44% and vomiting – 3.33%. The nature of the food workers eat, alcohol consumption and smoking affect the stomach disorders.

The results gathered from the paraclinical studies show that in 38.39% of the cases there are aberrations from the norm. 17.77% have elevated levels of transaminase serum activity - AST and ALAT. The value of these enzyme markers correlates with the hepatomegaly found in these workers.

TCA in urine is above the norm in 8.89% whereas the TCE - in 15.56% of the

examined workers. When analysing the data, we established that there are aberrations in more than 2 of the abovementioned markers in 4 out of the 90 workers in the study.

The conducted study has established that the cardiovascular syndrome is demonstrated primarily as arterial hypertonia in ages 40-55 – 13.33%. It is also easy to notice the lowering of the age in which the cardiovascular diseases begin. This can be explained by stress, mental and emotional tension and a series of other harmful factors such as smoking, alcohol consumption and unhealthy eating habits. The complex action of these factors and the toxic substance – TCE determine the number of neurological diseases in the examined operators – 7.78%.

After an overall examination, pain in the epigastric region (3.33%) and in the right subcostal region (14.44%) is found in much fewer subjects. Hepatomegaly is found in 16.67%. The echocardiographical examination of the liver shows minor enlargement – up to 2 cm under the costal arc. This objective condition is found primarily in workers aged 46-55 with

employment history of more than 10 years. Having compared data from clinical, laboratory and functional examinations, we have identified three main liver diagnoses in the examined subjects (**figure 4**).

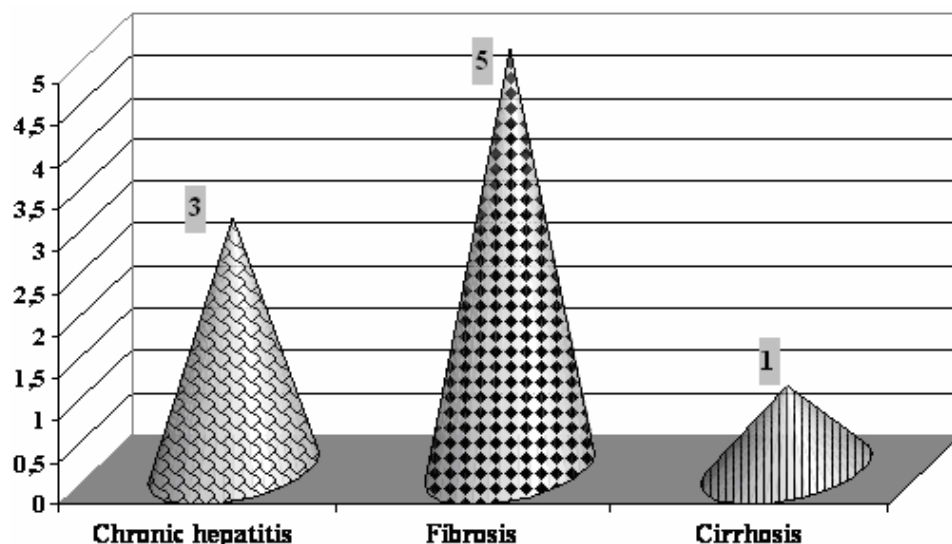


Figure 4. DISTRIBUTION OF STUDIED WORKERS BY DIAGNOSES OF THE LIVER SYSTEM

The factors that may cause the diagnosed hepatomegaly are discussed for each case. These factors are: Some chronic diseases (gastritis, ulcer, holecistitis), metabolic disorders, past hepatotropic infections, regular alcohol use, current or past exposure to toxic substances. Given the anamnesis data regarding risk factors, harmful habits and the health status of the studied workers, we cannot accept the purely toxic genesis of the liver enlargement. On the other hand, as far as the importance of the abovementioned factors is concerned, the long-term contact with hepatotropic substances contributes to the origination of liver disorders or further complicates them through more frequent functional aberrations.

CONCLUSIONS

1. The established changes in the health status of machine operators of rubber conveyor belts in "Trojanovo 1" mine and "Trojanovo North" mine controlled by Mini Maritsa Iztok EAD bear witness to initial damage due to toxic chemical substances – TCE.
2. Diseases affecting the blood circulation organs and the bone-muscular system, eye diseases and diseases of the respiratory, digestive and neural systems are predominant in the identified sick rate structure.
3. The results of the conducted enzyme study correlate with the hepatomegaly in 16.67% of the examined workers.

4. TCA metabolites are above the norm in 8.89% whereas the TCE - in 15.56% of the examined workers.
5. The conducted analysis shows that 4 out of the 90 examined subjects show aberrations in more than 2 markers.
6. The high overlapping of standard risk factors – smoking, alcohol consumption and obesity – increase the risk due to exposition to the toxico-chemical factor, TCE, and justifies the need for implementing preventive measures of different nature as well as periodic medical monitoring.

REFERENCES

1. Алексиева Цв. Професионална патология, С, МФ, 1982
2. Попов Т., З. Запрянов. Атлас по токсикокинетика, С, 1984 137-138
3. Лазарев Н. В., А. Левина. Вредные вещества в промышленности, „Химия”, Ленинград, 1976, 66-74
4. Moore LE, Boffetta P, Karami S, Brennan P, Stewart PS, Hung R, Zaridze D, Matveev V, Janout V, Kollarova H, Bencko V, Navratilova M, Szeszenia-Dabrowska N, Mates D, Gromiec J, Holcatova I, Merino M, Chanock S, Chow WH, Rothman N. Cancer Res. 2010 Aug 15;70(16):6527-36. Epub 2010 Jul 27
5. Tao L, Ge R, Xie M, Kramer PM, Pereira MA. J Biochem Mol Toxicol. 1999;13(5):231-7.