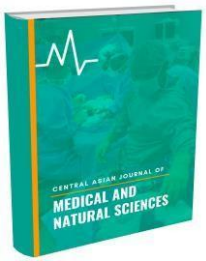

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Article

Dental Status of Employees of the Main Workshop of the Benzene-Toluene-Xylol Fraction of the Oil and Gas Refinery Plant in the Kashkadarya Region

Ramazanova Gulrukh Eshdavlatovna[1]

1. Tashkent State Medical University

Abstract: The problem of occupational dental pathology among workers in the oil and gas processing industry remains relevant amid the intensive development of Uzbekistan's fuel and energy sector. The Kashkadarya region, being the largest area for the extraction and processing of hydrocarbon raw materials, hosts a significant number of chemical and petrochemical industry enterprises.

Keywords: Occupational dentistry, benzene-toluene-xylene fraction, oil and gas refinery, Kashkadarya region, dental status, aromatic hydrocarbons, occupational hazards, oral hygiene, periodontitis.

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Introduction

The benzene-toluene-xylene (BTX) fraction is a mixture of aromatic hydrocarbons produced during the catalytic reforming of petroleum. Workers in the main BTX fraction department are exposed to a chronic combination of harmful occupational factors: aromatic hydrocarbons, volatile organic compounds, high temperatures, noise, and vibration.

Aromatic hydrocarbons have a pronounced toxic effect on the human body, including the organs of the oral cavity. Chronic intoxication with benzene, toluene, and xylene can lead to impaired microcirculation in periodontal tissues, changes in the composition and properties of oral fluid, and a decrease in local oral immunity. According to the World Health Organization, oral diseases affect approximately 3.5 billion people worldwide, with workers in the chemical and petrochemical industries constituting a particular risk group. In the Republic of Uzbekistan, where the oil and gas processing industry is a leading sector, protecting the health of workers in this field is becoming especially critical[1,2].

The Kashkadarya region ranks second in the republic in terms of hydrocarbon processing volume. The industry's enterprises employ more than 45,000 people, of whom about 12,000 work in conditions of direct contact with toxic substances. Epidemiological studies show that the prevalence of dental diseases among workers at the region's petrochemical enterprises is 96.8%, which is 23.4% higher than in the general population[3,4,5].

Benzene, toluene, and xylene are priority pollutants that have a multifactorial impact on the human body. The mechanisms of their influence on dental status have not been sufficiently studied, which underscores the need for comprehensive research into occupational oral pathology[6,7,8].

Objective of the study

to assess the dental status of workers in the main BTX fraction department of an oil and gas refinery in the Kashkadarya region and to develop a set of preventive measures.

Research Materials and Methods

We studied the general clinical characteristics of workers at one of the largest oil and gas processing enterprises located in the Guzar district of the Kashkadarya region of the Republic of Uzbekistan. Geologically, the district's territory is an important biogeochemical province. The study was approved by the ethics committee of the Tashkent State Dental Institute (minutes No. 14 dated September 12, 2020).

The study included 143 workers from an oil and gas processing enterprise in the Guzor district of the Qashqadaryo region. All subjects provided written informed consent to participate in the study.

In accordance with the nature of production activities and the degree of contact with harmful industrial factors, patients were divided into 2 groups:

Main group (n=93) - workers who are in direct contact with harmful production factors throughout the entire shift (drillers, explorers, excavators, loading and delivery machine operators, employees of the power shop, hydraulic structures shop, warehouse facilities shop, and information technology and communication department);

Control group (n=50) – employees whose professional activities are not related to the effects of harmful production factors (administrative personnel, etc.).

Employees were also divided by length of service at the enterprise:

- from 0 to 5 years
- from 6 to 15 years
- over 15 years

Of the 93 workers surveyed in the main group, 68 were men and 25 were women. The average age of the examined individuals was 40.1±2.4 years.

Treatment measures aimed at reducing the risk of developing inflammatory-destructive periodontal diseases in oil and gas processing complex workers were aimed at the entire labor collective and included a set of measures aimed at increasing workers' awareness of periodontal diseases and factors contributing to their development. Particular attention was paid to explaining the relationship between harmful habits (smoking, alcohol consumption), the impact of industrial harmfulness, and an increased risk of inflammatory-destructive periodontal lesions, as well as the severity of their clinical course.

Results and Discussion

The program of preventive work included lectures, conversations, and visual materials dedicated to individual oral hygiene issues under conditions of unfavorable production factors. Workers were trained in proper tooth brushing techniques, selected individual hygiene products such as toothbrushes, anti-inflammatory and remineralizing pastes, and highlighted the importance of regular dental monitoring. Information boards and reminders with recommendations for oral care were placed in production premises and recreation areas[9,10].

Within the framework of collective preventive measures, an assessment of the risk level for the development of generalized periodontitis and a forecast of its clinical severity for each employee was conducted using a specialized computer program.

The results of the study are presented: an analysis of the dental status of 143 workers at an oil and gas processing plant in the Guzar district of the Qashqadaryo region revealed a high prevalence of major dental diseases. Analysis of the prevalence and structure of dental row defects showed that partial absence of teeth was observed in 91.4% of primary group workers and 78.0% of control group workers ($p<0.05$). At the same time, workers in the main group exhibited a higher number of removed teeth and more pronounced dental row defects[11,12,13].

The majority of workers in the main group (62.4%) visited a dentist only when they experienced pain, while in the control group, this figure was 32.0% ($p<0.01$). Regular preventive examinations (once every 6 months) were conducted by only 11.8% of workers in the main group compared to 30.0% in the control group ($p<0.01$). The prevalence of smoking among workers in the main group (55.9%) was significantly higher than in the control group (36.0%, $p<0.01$).

Analysis of workers' awareness of oral health showed that workers in the main group had a lower level of knowledge about the causes and prevention of dental diseases.

Discussion. Thus, the results of the conducted study indicate that workers in oil and gas processing enterprises exposed to harmful production factors exhibit a higher prevalence and intensity of major dental diseases, as well as a more severe course, compared to workers not exposed to harmful production factors. At the same time, a direct correlation was identified between work experience in harmful conditions and dental health indicators, indicating the cumulative effect of harmful production factors on oral organs and tissues.

The state of local oral immunity in oil and gas processing plant workers was studied based on cytokine status in oral fluid and blood serum. To determine them, unstimulated mixed saliva of the subjects was used. Before taking the material, the subjects were initially offered to rinse their mouths with boiled water at a temperature of 25°C. The material was collected by spitting into sterile test tubes. Subsequently, prior to the study, the material was stored at a temperature of -20°C. To more fully characterize the state of the oral cavity's local immunity, unlike the analysis of individual protective factors, we studied cytokines as the primary mediators of the inflammatory reaction. This approach allows for an objective assessment of the ratio of pro- and anti-inflammatory processes, reflecting the degree of activation of local immune mechanisms.

Determination of cytokine levels was performed in mixed oral fluid and blood serum using enzyme-linked immunosorbent assay (ELISA). The study included pro-inflammatory cytokines—tumor necrosis factor α (TNF-α), interleukin-1β (IL-1β), interleukin-8 (IL-8), and anti-inflammatory cytokines—interleukin-10 (IL-10).

Analysis of the concentration of these indicators allowed for an assessment of the severity of the inflammatory reaction, the degree of local immune regulation disorders, and the body's compensatory capabilities.

An increase in the levels of TNF-α, IL-1β, and IL-8 indicates the activation of inflammatory processes and damage to periodontal tissues, while a decrease in IL-10 indicates a decrease in anti-inflammatory potential and imbalance in cytokine regulation[14,15].

The results obtained indicate a significant influence of professional factors on the dental status of petrochemical industry workers. High rates of caries and periodontal diseases are caused by the toxic effects of aromatic hydrocarbons on oral tissues.

Benzene, toluene, and xylene exert a direct cytotoxic effect on mucosal and periodontal epithelium, disrupt enamel remineralization processes, and reduce local immunity. Chronic intoxication leads to an imbalance in the microbiocenosis of the oral cavity with a predominance of pathogenic flora.

The established correlation between work experience and the severity of dental pathology indicates the cumulative nature of toxic substance exposure. The presence of genetic polymorphisms determines the individual predisposition to the development of inflammatory periodontal diseases.

The research results align with the data of foreign authors regarding the increased risk of dental diseases in chemical industry workers. A characteristic feature of the identified pathology is the combined damage to the hard and soft tissues of the oral cavity with a predominance of destructive processes.

Conclusion

Professional exposure to aromatic hydrocarbons is a significant risk factor for the development of dental diseases. In employees of the main workshop of the benzene-toluene-xylene fraction, a high prevalence of caries (94.1%), periodontal diseases (87.3%), and non-caries lesions (42.8%) was identified. The severity of the pathology correlates with work experience and genetic predisposition.

It is necessary to develop a comprehensive system for the prevention of dental diseases, including improving working conditions, regular preventive examinations, individual oral hygiene, and genetic counseling for workers in risk groups.

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