Chronic Laryngitis in Glassblowers

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Abstract: Glassblowers are exposed to numerous physical and chemical noxious factors at their workplace. Mucosal layer of upper aerodigestive tract (nose, oral cavity, pharynx and larynx) is particularly vulnerable to the influence of these factors. Inhalation of hot gases, dust particles, and oral contact with glassblower's pipe are the most important factors that can cause chronic inflammation of the upper respiratory tract. The aim of this study was to examine the prevalence of chronic laryngitis in the group of glassblowers and control group of workers and to examine whether the observed differences depend on the membership in these two groups, on the duration of exposure, or on both factors. The results of the study show significantly higher prevalence of chronic laryngitis among glassblowers than among control group of workers employed in the same plant. On the other hand, the duration of exposure was not statistically significant factor for chronic laryngitis. The exposure to risk factors on the working place represents an independent risk factor for the occurrence of chronic laryngitis among glassblowers, when adjusted for other possible confounders, such as age, years of service, smoking habits and alcohol consumption.

Key words: Glass industry, Glassblowers, Noxious factors, Occupational exposure, Chronic laryngitis

Introduction

Glass industry plays an important part in the economical prosperity of many societies, partially thanks to the wide and general application of glass products in man's everyday activities. One of the oldest and most important ways of glass production is its manual production by glassblowing. Glassblowers are artists of glass fashion, but their work is extremely difficult and associated with different health hazards. Glassblowers are frequently exposed to high air temperature, low air humidity, intensive infrared radiation, several evaporations and gases from molten glass mixture in furnaces on the workplace.

Exposure to intensive infrared radiation from furnaces, inhalation of hot gases and dust particles and oral contact with glassblower's pipe are the most important forms of exposure to noxious agents in glassblowers. Considering the fact that a piece of molten glass on glassblower's pipe has average temperature of 1,100°C, it becomes obvious that glassblowers inhale various hot gases and fumes arising from molten glass¹.

Numerous chemical substances, such as metal oxides (arsenic, alum, antimony, cadmium, chromium, manganese, nickel, and copper), as well as acrolein and asbestos, are widely used in the glass industry for the production, coloring and finalizing of glass products. Vapors, fumes and dust containing these substances most frequently express irritant and toxic influence on the laryngeal mucosa.

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Chronic laryngitis is defined as a chronic nonspecific inflammation of laryngeal mucosa. Methodologically, only the non-infective inflammation of laryngeal mucosa was taken into account in the present study. Various hazards have already been proved as possible causes of the disease. Environmental factors such as climate (microclimate), volatile irritant chemical substances, fumes and dust originating from the working conditions, could be some of them. Furthermore, a preexisting chronic inflammation of upper aerodigestive pathways, mouth breathing due to nose obstruction, smoking, alcohol abuse, voice abuse etc. must be considered as additional risk factors for the occurrence of chronic laryngitis.

Exposure to these factors causes irritation and subsequent chronic inflammation of laryngeal mucosa, with hyperemia and mild edema that are signs of an initial stadium of chronic laryngitis—catarrhal chronic laryngitis. Long lasting exposure leads to enlargement of edema and to hypertrophy of laryngeal mucosa—hypertrophic chronic laryngitis. The final stage of this disease is atrophic chronic laryngitis with marked decrease of blood perfusion and secretion of laryngeal mucosal glands²⁾. These three stages of the pathological process in the larynx are treated as independent categories of chronic laryngitis³⁾.

The term laryngeal precancerosis is used to describe such changes on laryngeal mucosa that lead to development of laryngeal cancer in greater number of cases. Histologically, laryngeal precancerosis includes chronic laryngitis with dysplasia and keratinizing papillomas. Dysplasia of laryngeal epithelium is metaplasia into keratinizing squamocellular epithelium followed with some degree of cellular atypia⁴⁾.

According to the Ljubljana classification for the diagnosis of laryngeal precancerous lesions, epithelial hyperplastic laryngeal lesions (EHLL) are graded to: simple hyperplasia, abnormal hyperplasia, atypical hyperplasia and carcinoma *in situ*⁵⁾. A higher degree of laryngeal mucosal dysplasia is connected with higher possibility for malignant transformation. Macroscopic signs of malignant transformation of any precancerous lesion are long lasting surrounding mucosal inflammation, the occurrence of granules or papillae on the lesion surface, prolonged duration of the lesion and recidivism after surgical removing⁴⁾.

The aim of this study was to examine the prevalence of chronic laryngitis in the group of glassblowers (exposed group) and control group of workers, based on objective findings on laryngeal mucosa and to examine whether the differences in the observed prevalence of the chronic laryngitis depend on the membership in these two groups of workers, on the duration of exposure, or on both factors.

Materials and Methods

The study was performed in Serbian Glass Factory in Paracin, Serbia and Montenegro, during autumn 2000. The exposed group consisted of randomly chosen 100 male glassblowers, whereas the control group consisted of 100 male workers employed in the same manufacturer plant, who has never been engaged in glassblowing. None of the participants has been working on other work places before employment in the glass factory.

A self administered specific questionnaire consisting of participant's general information (age, workplace, length of employment), his hazardous life-style habits (smoking and alcohol consumption) and medical history of previous diseases, injuries or surgical procedures on upper aerodigestive tract was distributed to every participant. Considering smoking habits, subjects reported if they had never smoked or were current smokers, the latter group reported the average number of cigarettes they smoked per day. Alcohol consumption was estimated based on the frequency of consumption of any alcoholic drink during lifetime. Participants were classified into three groups according to the total daily intake of alcohol: rare or never drinkers (consuming less than one beverage a day), moderate drinkers (drinking one to two beverages a day) and heavy drinkers (consuming more than two drinks a day), according to guidelines from the National Institute on Alcohol Abuse and Alcoholism⁶⁾.

Physical examination of the participants was performed by indirect mirror laryngoscopy that revealed objective findings in the larynx. Laryngomicroscopy with biopsy was performed only in cases with medical indications. The diagnostic criteria for chronic laryngitis included: long lasting edema, hyperemia or atrophic changes and dryness of laryngeal mucosa, particularly of vocal cords.

Descriptive statistics were presented as mean values $\pm$ standard deviation (SD) for numeric variables, or as percents for categorical variables. The differences in average years of age and years of service between exposed and control group were compared using Student *t*-test; whereas the differences in smoking, alcohol consumption, education and the frequency of diagnosed medical conditions were tested by chi-square test. Mantel-Haenszel statistics was performed for the analysis of the risk of the occurrence of several types of chronic laryngitis by group membership (exposed vs. control group).

Logistic regression model was used in order to estimate the relative risk for the occurrence of chronic laryngitis based on a set of independent predictor variables, such as age,

Table 1. Main characteristics of the studied population

Tested parameters	Group		P Value
	Exposed (N=100)	Control (N=100)	
Age (yr)	37.5 ± 7.9	39.6 ± 8.9	0.077 [†]
Years of service	19.3 ± 8.2	17.5 ± 8.1	0.131 [†]
Smoking habits			
Nonsmokers	34 (34.0%)	26 (26.0%)	0.426*
Up to 10 cigarettes/d	10 (10.0%)	12 (12.0%)	
11–20 cigarettes/d	56 (56.0%)	62 (62.0%)	
Alcohol consumption			
Rarely or never	23 (23.0%)	26 (26.0%)	0.731*
Moderate (1–2 drinks/d)	68 (68.0%)	61 (61.0%)	
Heavy (more than 2 drinks/d)	9 (9.0%)	13 (13.0%)	
Education			
Elementary school	86 (86.0%)	91 (91.0%)	0.109*
Semi-qualified workers	1 (1.0%)	0 (0.0%)	
Qualified workers	13 (13.0%)	9 (9.0%)	

[†]Student *t*-test. *Pearson Chi-Square test.

Table 2. The distribution of the occurrence of chronic laryngitis in the examined groups

Group N (%)	Normal finding	Chronic laryngitis			Total
		Catarrhal chronic laryngitis	Hypertrophic chronic laryngitis	Atrophic chronic laryngitis	
Exposed	34 (34.0%)	62 (62.0%)	1 (1.0%)	3 (3.0%)	100 (100.0%)
Control	71 (71.0%)	28 (28.0%)	1 (1.0%)	0 (0.0%)	100 (100.0%)
Total	105 (52.5%)	90 (45.0%)	2 (1.0%)	3 (1.5%)	200 (100.0%)

Pearson Chi-Square=28.883; *p*=0.000.

years of service, smoking habits, alcohol consumption and group membership (exposed or control group).

Results

The main characteristics of the studied groups at the time of the investigation revealed no statistically significant differences considering the average age of the participants, years of service, smoking habits, alcohol consumption or education (Table 1).

Chronic laryngitis, predominantly catarrhal chronic laryngitis, was diagnosed in 62% of the participants from exposed group and in only 28% of the participants from the control group (Table 2), the differences between the groups being highly statistically significant (*p*<0.01).

Furthermore, no malignant diseases were diagnosed and only three cases of dysplasia of laryngeal mucosa were found in the examined groups. Two out of three cases of dysplasia

were observed among exposed workers—one described as moderate dysplasia and the other one described as severe dysplasia, and one case of moderate dysplasia was diagnosed in the control group. These results are not presented in table considering the fact that they show no statistically significant difference (Pearson Chi-Square=1.005; *p*=0.605) and due to small number of cases.

Exposed workers had four to five time greater risk of the overall occurrence of chronic laryngitis in comparison to control group, as well as for the occurrence of catarrhal chronic laryngitis (Table 3). The statistical estimation for the occurrence of hypertrophic chronic laryngitis revealed no significance, and the estimation of the risk for atrophic chronic laryngitis was not possible due to small number of cases.

The prevalence of chronic laryngitis was around 66% in all subgroups by years of service of exposed workers (Table 4). On the other hand, in the control group, the prevalence

Table 3. The difference in the frequency of several types of chronic laryngitis

Chronic laryngitis	Pearson Chi-Square	p	Odds Ratio*	95% Confidence Interval
Chronic laryngitis – all types	27.449	0.000	4.753	2.613–8.643
Catarrhal chronic laryngitis	25.843	0.000	4.624	2.525–8.469
Hypertrophic chronic laryngitis	0.277	0.599	2.088	0.127–34.402
Atrophic chronic laryngitis	5.921	0.015	–	–

*Mantel-Haenszel Common Odds Ratio Estimate.

Table 4. The distribution of the occurrence of chronic laryngitis in the examined groups by years of service in glass factory

Group		Years of service				Chi-Square (p value)
		Up to 5	6–15	16–25	Over 25	
Exposed	Total subjects	3	30	35	32	0.010
	Number of diseased subjects (%)	2 (66.7)	20 (66.7)	23 (65.7)	21 (65.6)	(1.000)
Control	Total subjects	7	33	39	21	5.447
	Number of diseased subjects (%)	0 (0)	13 (39.4)	9 (23.1)	7 (33.3)	(0.142)
Chi-Square test (p value)		5.833 (0.016)	4.686 (0.030)	13.663 (0.000)	5.306 (0.021)	

Table 5. Relative risk for the occurrence of chronic laryngitis adjusted for age, years of service, smoking habits and alcohol consumption

Predictor variables	B	Sig.	RR*	95% CI
Group Control			1	
Exposed	1.803	0.000	6.071	3.060–12.044
Age	0.048	0.147	1.050	0.983–1.121
Years of service	–0.022	0.517	0.978	0.916–1.045
Smoking habits	0.116	0.322	1.123	0.893–1.411
Alcohol consumption	0.176	0.352	1.193	0.823–1.728
Constant	–3.005	0.004	0.050	

*Logistic regression model.

of chronic laryngitis ranged from 0% in the subgroup employed less than five years ($p < 0.05$), by 23% in workers employed 16–25 yr ($p < 0.01$), 33% among control workers employed more than 25 yr ($p < 0.05$) and up to 39% in workers employed 6–15 yr in glass factory ($p < 0.05$). These differences between examined groups revealed statistical significance, but no differences in the prevalence of chronic laryngitis were observed among both exposed workers and control group by years of service.

Taking all risk factors into account, the average risk for the occurrence of chronic laryngitis among glassblowers in comparison with control (unexposed) workers was increased up to six times, when adjusted for age, years of service, smoking habits and alcohol consumption ($p < 0.001$) (Table 5).

Discussion

Larynx, among other functions, has an important role in the protection of the tracheobronchial tree from the environmental harmful influences. Epiglottis, ventricular folds and vocal cords in particular serve as barriers for the direct influence of hot and dry air, dust, harmful evaporations and gasses on the tracheobronchial tree.

The strengths of this study are that it was constructed as prevalence study, consisting of two groups of workers, similar in age, years of service, education and life-style habits such as smoking and alcohol consumption. Considering the main finding of the study that chronic laryngitis was diagnosed in around two thirds of the participants from exposed group and in less than a third of the participants from the control group, it becomes obvious that the exposure to hazardous

agents during glassblowing process is the most important independent risk factor for the occurrence of the disease. This exposure could be explained by closer contact with noxious agents during oral contact with glassblower's pipe and due to smaller distance from glass furnace in comparison with the control group. The study of Szmaja *et al.*⁷⁾ confirms these results. Studying the symptoms of upper aerodigestive tract in glassblowers in a glass factory in Poland they found higher prevalence of upper respiratory chronic diseases, such as rhinitis, laryngitis, and pharyngitis among glass workers. The authors explained their results by the exposure of glass workers to silica dust.

Unexpectedly high incidence of chronic laryngitis positive findings (67%) in the exposed group was found after a short time of their employment (0–5 yr). It could be explained by rapid and intensive exposure to harmful occupational environmental factors. Laryngeal mucosa of the exposed workers at this time was not adapted to these specific environmental factors. These facts also confirm that harmful agents have more significant influence on the glassblowers than on the control group of workers.

The results of the study revealed a small absolute number of dysplastic changes of laryngeal mucosa among all participants. According to the criteria from World Health Organization, three types of dysplasia—mild, moderate and severe—are distinguished regarding the degree of cellular atypia³⁾. As shown earlier, two cases of dysplasia were described as moderate dysplasia (each in one examined group), and only one case of severe dysplasia among exposed workers.

Glassblowers can be exposed to various carcinogens, such as nickel, chromium and asbestos, as shown in many studies. Raithel *et al.* have studied four German glass factories and found high air concentration of nickel, as well as high concentration of this metal in urine samples of glassblowers than in unexposed workers⁸⁾. Nickel compounds are related to malignancies of nose, paranasal sinuses, lungs, and possibly to laryngeal cancer⁹⁾. Compounds of chromium 6+ are one of causative factors for the lung, paranasal sinuses and laryngeal cancer. The incidence of malignancies of respiratory tract in workers exposed to chromium is 15–20 times higher than in unexposed population¹⁰⁾. The influence of dust containing asbestos on the appearance of malignancies of the larynx, oral cavity and digestive tract was also described previously¹⁰⁾. Kambic *et al.* have found higher incidence of epithelial hyperplastic laryngeal lesions after exposure to asbestos¹¹⁾.

Although glassblowers are exposed to numerous carcinogens on their workplace, malignant diseases of the

larynx were not found in this study. On the contrary to our findings, many other studies found increased prevalence of malignancies of the larynx and other parts of upper aerodigestive tract in glassblowers^{12, 13)}. In a large study performed among 468 Italian glass workers employed in glass factory, the estimated standardized mortality rate due to laryngeal cancer was 4.5¹⁴⁾. Similar findings were observed in another cohort of 3,390 glass workers in 17 industrial facilities in Italy. The observed mortality was above the expected for larynx (standardized mortality ratio SMR=166, 90% confidence interval=90–282), and this mortality increased with years of exposure¹⁵⁾. Unfortunately, a recent multicentre population-based case-control study performed in France, Italy, Spain and Switzerland showed a risk of cancer of the larynx/hypopharynx for workers engaged in jobs in the construction, metal, textile, ceramic, and food industries and in railway transport, but failed to recognize glassblowers as high risk group of workers¹⁶⁾. The observed differences between various investigators can be explained by various methodological approaches to the problem (prospective or retrospective studies), by the fact that patients with malignant diseases were either moved to other work places, or were retired or deceased and might be also masked by the differences in other environmental and occupational factors affecting workers in various countries.

Conclusion

Due to an intensive influence of the harmful environmental factors at the workplace, glassblowers are exposed to significantly higher risk for the occurrence of chronic laryngitis than other workers in glass manufacturing plant. This risk remained high even when other possible confounding factors, such as smoking habits, alcohol consumption and exposure period (years of service) were taken into account. This study gives a base for further evaluation of this problem in occupational medicine.

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