

CAN THE OCCURRENCE OF BRONCHIAL ASTMA IN POTROOM WORKERS BE PREVENTED? *

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Bronchial reactivity was evaluated in a group of 35 workers at preemployment examination using the metacholine test. Three workers showed an increased bronchial reactivity, the rate being in accordance with the previous experience. Ten randomly chosen subjects with normal reactivity, who were engaged as potroom workers, were followed up during a two-to-five-year period. None of them experienced any significant respiratory complaints and their bronchial reactivity also remained normal. Only one worker had a borderline finding (PD₂₀FEV₁). Although selection at preemployment medical examination is a measure that has to be used only exceptionally, based on the finding obtained by non-specific bronchoprovocation challenge it seems that it can be recommended in the case of that particular exposure.

Key terms: bronchial hyperreactivity, electrolytic extraction of aluminium, metacholine testing, occupational exposure, preemployment medical examination

Electrolytic extraction of aluminium is associated with exposure to a variety of fumes and gases. Fluorides in the form of hydrogen fluoride and particulate fluoride are of primary importance from the standpoint of respiratory disease. As early as 1936 *Frostad* (1) described a respiratory disorder in aluminium smelter workers that clinically resembled asthma. It was suggested that the syndrome had an allergic background precipitated by fluoride exposure (2, 3). By contrast, *Bruusgard* (4) found that although there was a fivefold increase in bronchial asthma-like syndrome among such workers, no association with atopy could be proved.

Our own study - initiated by the workers' complaints of acute respiratory symptoms which they associated with occupational exposure and which caused a large number of absences from work - led to believe that the occurrence of bronchial asthma in workers

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engaged in the electrolytic extraction of aluminium could be explained in terms of induced bronchial hyperreactivity (5, 6). In the meantime, the results of several other studies were in accordance with those findings (7-9). To clarify a possible role of atopy in the occurrence of potroom worker's asthma a further study was performed. The results of that study (10) supported our previous findings that acute respiratory impairment in some workers was most probably based on bronchial hyperreactivity and not on an allergic mechanism. It has also been shown that the increased bronchial reactivity once induced has a tendency to persist even after cessation of exposure (11).

Based on those observations the question has been raised whether it is advisable to select workers at preemployment examination using non-specific bronchoprovocation testing.

SUBJECTS AND METHODS

To get an objective answer, bronchial reactivity was evaluated in a group of 35 workers at preemployment examination using the metacholine test. The applied method of inhalation and dosing of aerosol belonged to the methods of continuous nebulisation and intermittent aerosol inhalation with a fixed number of non-dosimeter regulated breaths (12) at the same volume and different metacholine concentration. Metacholine was diluted in physiological solution to the concentrations: 0.08, 0.15, 0.31, 0.62, 1.25, 2.50, 5.00, 10.0, 25.0 mg/ml. The first concentration was taken as zero and the last one as eight. The cumulative inspired dose that caused a drop in FEV₁ of more than 20%, compared with the value measured after the inhalation of physiological solution, was taken as PD₂₀ FEV₁. A 46.5 cumulative dose unit was considered to be the limit value and served to distinguish a hyperreactive person from a normoreactive one (12). Three workers showed an increased bronchial reactivity, the rate being in correspondence with the previously experienced. Ten of those with normal reactivity, randomly chosen, who worked in potrooms, were followed up during a two-to-five-year period. Non-specific bronchoprovocation testing was performed at the end of the observation period thus including the subjects with the longest exposure experience (five years), and shorter duration of exposure.

Data on exposure levels were also considered. The values obtained by the use of personal samplers for individual pollutants (Alu Swiss process for the electrolytic extraction of aluminium with prebacked anodes) compared with maximum allowable concentration (MAC) values were occasionally higher for hydrogen fluoride (range: 0.20-2.7 mg/m³; MAC: 1.7 mg/m³). For particulate fluorides they were mainly within the MAC values (range: 0.02-1.6 mg/m³; MAC (as F): 1 mg/m³ weighted average) and for sulphur dioxide below them (range: 0.08-4.0 mg/m³; MAC: 10 mg/m³).

RESULTS

The results are shown in the Table. None of the followed-up workers experienced any marked respiratory complaints. Only two had occasional cough, and their bronchial reactivity remained also normal. Only one worker had a borderline finding i.e. a 20% drop of FEV₁.

Table. Follow-up of a group of normoreactive potroom workers selected at the preemployment examination

Initials	Age (year)	History of atopy	Smoking habit	Length of exposure (year)	Respiratory symptoms during exposure*	Bronchoprovocation challenge**
JA	36	0	moderate	5	+ -	normoreactive
MT	28	0	moderate	4	+ -	normoreactive
JT	24	+	light	4	0	normoreactive
MU	29	0	non-smoker	3	0	normoreactive
ZU	26	0	light	4	0	normoreactive
MŠ	33	0	light	3	0	normoreactive
VD	26	0	moderate	5	0	normoreactive
ŽG	27	0	moderate	5	0	normoreactive
MJ	37	0	light	5	0	normoreactive
VT	25	0	light	2	0	borderline reaction

*Cough, dyspnoea and wheezing (+); cough only (+-); absence of symptoms (0)

**Testing performed at the end of the followed-up length of exposure

CONCLUSION

Although selection is a measure which has to be used only exceptionally, it seems that it could be recommended. Namely, previous experience, when such an approach was not implemented, shows that among newly employed workers in potrooms about 10 per cent used to develop an asthma-like syndrome starting from only several months up to two years after the beginning of work.

Unfortunately, the plant where this investigation was performed is no longer in operation. It was destroyed during the aggression which Croatia has suffered starting from 1991.

REFERENCES

1. Frostad EW. Fluorine intoxication in Norwegian aluminium plant workers. *Tidsskr Nor Laegefor* 1936;56:179. (In Norwegian)
2. Evang K. Investigation among Norwegian workmen as to the occurrence of bronchial asthma, acute cryolite poisoning and fluorosis. *Nord Hyg Tidsskr* 1938;19:117-48. (In Norwegian and German abstract)
3. Midttun O. Bronchial asthma in the aluminium industry. *Acta Allergol* 1960;15:208-21.
4. Bruusgaard A. Asthma-like disease among Norwegian aluminium plant workers. *Tidsskr Nor Laegefor* 1960;80:796-7. (In Norwegian and German abstract)
5. Šarić M, Gomzi M, Hrutić O, Pauković R, Rudan P. Respiratory impairment in the electrolytic extraction of aluminium. *Int Arch Occup Environ Health* 1979;42:217-21.
6. Šarić M, Žuškin E, Gomzi M. Bronchoconstriction in potroom workers. *Br J Ind Med* 1976;36:211-5.
7. Maestrelli P, Marcer G, Clonfero E. Occupational asthma in the aluminium industry. *Eur J Respir Dis* 1981;62(Suppl 113):92-3.
8. O'Donnell TV, Welford B, Coleman ED. Potroom asthma: New Zealand experience and follow-up. *Am J Ind Med* 1989;15:43-9.
9. Kongerund J. Occupational exposure and asthma. *Norsk Tidsskr Arb Med* 1991;Suppl 2:3-192.

10. Šarić M, Godnić-Cvar J, Gomzi M, Štilinović L. The role of atopy in potroom workers' asthma. *Am J Ind Med* 1986;9:239-42.
11. Šarić M, Marelja J. Bronchial hyperreactivity in potroom workers and prognosis after cessation of exposure. *Br J Ind Med* 1991;48:653-5.
12. Pratter M, Irwin RS. The clinical value of pharmacologic bronchoprovocation challenge. *Chest* 1984;85:360.
13. Ofner B, Marelja J. Bronchial hyperreactivity testing with metacholine in aluminium potroom workers. *Arh hig rada toksikol* 1986;37:301-9 (in Croatian).

Sažetak

MOŽE LI SE SPRIJEČITI POJAVA BRONHALNE ASTME U RADNIKA U ELEKTROLITSKOJ EKSTRAKCIJI ALUMINIJA?

Od 35 radnika testiranih metakolinom u okviru zdravstvenog pregleda prije primanja na posao, 32 su imala uredan nalaz a trojica su pokazala povećanu nespecifičnu reaktivnost bronha. Nakon provedene selekcije, 10 radnika koji su na temelju urednog nalaza primljeni na rad u pogon elektrolitske ekstrakcije aluminija praćeno je u razdoblju od dvije do pet godina. U tom vremenskom intervalu nitko od njih nije razvio nikakve značajnije respiratorne tegobe. Kontrolni metakolinomski testovi pokazali su također nalaze u granicama normoreaktivnosti. Jedino je jedan radnik razvio granični nalaz testa ($PD_{20}FEV_1$). Dobiveni rezultati, makar se radi o malom broju ispitanika, upućuju na opravdanost da se preporuča selekcija prilikom prethodnih pregleda korištenjem testa nespecifične reaktivnosti bronha. Međutim, kada je riječ o tvornici na koju su se ispitivanja odnosila, treba nažalost, navesti da je već početkom ratne agresije na Hrvatsku ona onespособljena za daljnju proizvodnju.

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Ključne riječi: bronhalna preosjetljivost, elektrolitska ekstrakcija aluminija, profesionalna izloženost, medicinski pregledi prije zapošljavanja, testiranje metakolinom