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 (PT25%FEV1). 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 1956 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, Brunsjord (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 16.5 cumulative dose unit was considered to be the limit value and served to distinguish a hyperreactive person from a normoactive 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 1): 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

<table>
<thead>
<tr>
<th>Initials</th>
<th>Age (year)</th>
<th>History of atopy</th>
<th>Smoking habit</th>
<th>Length of exposure (year)</th>
<th>Respiratory symptoms during exposure*</th>
<th>Bronchoprovocation challenge**</th>
</tr>
</thead>
<tbody>
<tr>
<td>JA</td>
<td>36</td>
<td>0</td>
<td>moderate</td>
<td>5</td>
<td>+</td>
<td>normoreactive</td>
</tr>
<tr>
<td>MT</td>
<td>28</td>
<td>0</td>
<td>moderate</td>
<td>4</td>
<td>+</td>
<td>normoreactive</td>
</tr>
<tr>
<td>JT</td>
<td>24</td>
<td>light</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>normoreactive</td>
</tr>
<tr>
<td>MU</td>
<td>29</td>
<td>0</td>
<td>non-smoker</td>
<td>4</td>
<td>0</td>
<td>normoreactive</td>
</tr>
<tr>
<td>ZU</td>
<td>26</td>
<td>0</td>
<td>light</td>
<td>3</td>
<td>0</td>
<td>normoreactive</td>
</tr>
<tr>
<td>MS</td>
<td>35</td>
<td>0</td>
<td>light</td>
<td>3</td>
<td>0</td>
<td>normoreactive</td>
</tr>
<tr>
<td>VD</td>
<td>26</td>
<td>0</td>
<td>moderate</td>
<td>5</td>
<td>0</td>
<td>normoreactive</td>
</tr>
<tr>
<td>ZG</td>
<td>27</td>
<td>0</td>
<td>moderate</td>
<td>5</td>
<td>0</td>
<td>normoreactive</td>
</tr>
<tr>
<td>MJ</td>
<td>37</td>
<td>0</td>
<td>light</td>
<td>2</td>
<td>0</td>
<td>borderline reaction</td>
</tr>
</tbody>
</table>

*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. Fristad EIV. Fluorine intoxication in Norwegian aluminium plant workers. Tidsskr For Laegefor 1960;20:179. (in Norwegian)
Sužetek

MOŽE LI SE SPRJEČITI POJAVA BRONHALNE ASTME U RADNIKA U ELEKTROLOŠKOJ
EKSTRAKCIJI ALUMINIJAA?

Od 35 radnika testiranih metakolinskijim testom u okviru zdravstvenog pregleda prije primanja
na posao, 32 su imala sredan nalaz a trojica su pokazala pozitivne nespecifične reaktivnosti bronha.
Nakon provodene selekcije, 10 radnika koji su na tom mjesecnu testu primijenjeni su rad u pogon
elektrološke ekstrakcije aluminija pruženo je u razdoblju od dvije do pet godina. U tom vremenskom
intervalu nitko od njih nije razvio nikakve značajne respiratorne bolesti. Kontrolni metakolinski
testovi pokazali su također nalaze u granicama normalne aktivnosti. Jedino je jedan radnik razvio
granice nalaz testa ("PD2/FEV"). Dobiveni rezultati, nakon se radilo u radnom prostoru ispitivača, upućuju
na opravdanost da se preporuči selekcija prilikom prethodnih pregleda korištenjem testa nespecifične
reaktivnosti bronha. Međutim, kada je riječ o tvornici na koju su se ispitivanja odnijela, treba nažalost,
navesti da je već početkom ratne agresije na Hrvatsku ona onesposobljena za daljnju proizvodnju.

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Ključne riječi: bronhalna presjetljivost, elektrološka ekstrakcija aluminija, profesionalna izloženost, medicinski
pregledi prije zapošljavanja, testiranje metakolinskom