Detection of changes on the central nervous system in aluminium welders

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Introduction

Aluminium has reached an important role in the transportation industry in the last decade due to its material characteristics. At present central nervous changes and changes in the lungs resulting from an occupational exposure to aluminium containing welding fumes are being discussed with controversial results.

Aims:

Aim of our longitudinal study was to assess in a group of aluminium welders and in a non-occupationally exposed control group among others changes on the central nervous system due to the exposure to aluminium (Al) containing welding fumes.

Methods:

Two cross sectional studies were carried out within 2 years (1999/2000 = Ex.1; 2001/2002 = Ex. 2) examining 46 employees from 5 enterprises with a long-term welding history and an educational, gender, and age matched control group of 37 non exposed workers. The welders mainly applied Gas Metal Arc Welding (GMAW, MIGWelding), only little Tungsten Inert Gas Welding (TIGWelding) and grinding was done. The study programme consisted of a standardised anamnesis, a physical examination including the neurological status, ambient and biological monitoring, pulmonary function tests, high resolution computertomography (HRCT) of the lungs and a broad spectrum of psychometric function tests. The neurobehavioral methods included a symptom questionnaire (modified Q16) and computerised and non-computerised tests: psychomotor performance (steadiness, line tracing, aiming, tapping), verbal intelligence (WST), simple reaction time, digit span, block design (HAWIE), symbol-digit substitution, digit span, switching attention (European Neurobehavioral Evaluation System, EURO-NES), and standard progressive matrices. The psychometric data were analysed by multivariate analysis of variance including age, education, and alcohol marker as covariates (MANCOVA). Occupational and non-occupational confounders were controlled for.

Results:

The Al-urine concentration in welders (mean pre/postshift) was 114 µg/g cr. (Ex. 1) and 137 µg/g cr. (Ex. 2) (Table1).

Table 1: Results 1999/2001

	Median	Range
Age at 01/09/2001 (years) (welders)	41.5	30 - 69
Age at 01/09/2001 (years) (controls)	40	26 - 69
Welding time at 01/09/2001 (years)	10	2 - 27
Al U mean preshift and postshift (Ex. 1) (µg/g crea) (welders)	89.3	17.9 – 345.6
Al U mean preshift and postshift (Ex. 2) (µg/g crea) (welders)	143.9	8.9 – 431.8
Al Plasma mean preshift and postshift (Ex. 1) (µg/l) (welders)	10.9	4.8 – 35.3
Al Plasma mean preshift and postshift (Ex. 2) (µg/l) (welders)	11.8	4.9 – 45.7
Al U preshift/crea (Ex. 1) (µg/g crea) (controls)	3.8	1.6 – 36.0
Al U preshift/crea (Ex. 2) (µg/g crea) (controls)	4.5	1.6 – 86.2
Al Plasma preshift (Ex. 1) (µg/l) (controls)	3.1	1 – 8.2
Al Plasma preshift (Ex. 2) (µg/l) (controls)	2.8	1.3 – 5.9
Digit span forward (Ex. 1) (points) (welders)	7	2 - 11
Digit span forward (Ex. 1) (points) (controls)	7	3 - 12
Digit span forward (Ex. 2) (points) (welders)	9	4 - 14
Digit span forward (Ex. 2) (points) (controls)	10	5 - 14
Reaction time (Ex. 1) (msec) (welders)	273	193 - 406
Reaction time (Ex. 1) (msec) (controls)	257	207 - 399
Reaction time (Ex. 2) (msec) (welders)	260	206 - 383
Reaction time (Ex. 2) (msec) (controls)	275	213 - 366

The Al-plasma concentration (mean pre/postshift) was 10.9 µg/l (Ex. 1) and 11.8 µg/l (Ex.2). Welders median age at 01/09/2001 was 41.5 years in comparison to 40 years for controls. Median welding time was 10 years at 01/09/2001. Mean cdt (biomarker for alcohol consumption) for welders was 5,1 U/l and for controls 6.2 U/l (in 2001). Welders showed a significantly poorer performance in symbol-digit substitution, subtests of switching attention, block design, and marginally poorer performance in digit span forward. Motor performance measures did not differ between welders and controls. Regression analyses show small but statistically significant relationships between Al-urine parameters and the above mentioned performance measures.

Conclusions:

The study confirms that aluminium welders may be subject of high aluminium exposure which can be relevant in the view of occupationnal medicine. The neurological results could be slight but nevertheless important indicators of possible neurological changes in the Al welders in our cohort. For final interpretation the results of the last cross sectional study 2003 have to be awaited.

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