

BIOLOGICAL MARKERS OF MANGANESE EXPOSURE AND EFFECTS IN MANGANESE MINERS: RESULTS OF MAGNETIC RESONANCE IMAGING AND NEUROBEHAVIOURAL TESTS

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Under this project, 348 manganese miners of an underground manganese mines were examined. The findings about these 348 manganese miners are presented in the annual report of the year 2002-2003. In the present study the results of Magnetic Resonance Imaging and Neurobehavioral Tests among 90 manganese miners selected from the 348 manganese miners are presented. These 90 miners were randomly selected on the basis of blood manganese levels and presence of neurobehavioral symptoms observed on clinical examination.

All these miners were subjected to Magnetic Resonance Imaging (MRI), neurobehavioral test battery and blood manganese and plasma neurotransmitter analysis. The neurobehavioral test battery included

tests for finger dexterity, simple reaction time and choice reaction time, hand steadiness, tweezer dexterity, forward and backward memory tests and digit symbol tests. The MRI with perfusion scanning was carried out using 1.5 Tesla equipment at Apollo Hospital, Ahmedabad. The MRI films were taken at following specifications: Axial T1WI SE (TR 500ms, TE 7.7ms, FOV 230 X 201 mm, slice thickness 5mm, interslice gap 1.5mm, NEX-2, matrix 512 X 448, Bandwidth 140 Hz/Px, Acquisition time: 3.43 min.)

The results of MRI suggested that 78 (86.7%) subjects had hyperintense signals in the globus pallidus region (Fig. 1). The other regions where hyperintensity was observed included substantia nigra in 66(73.3%), mesencephalic tegmentum in 44 (48.9%), anterior pituitary gland in 36 (40%) and hypothalamus in 33 (36.7%) subjects. The pallidal index (PI), which is defined as the ratio of the signal intensity of globus pallidus to sub cortical frontal white matter multiplied by 100, was calculated. The PI was significantly higher in those having blood manganese levels $>2\mu\text{g/dl}$ than those having blood manganese levels $\leq 2\mu\text{g/dl}$ ($F=6.4$, $df=88$, $p=0.01$). However no significant difference in the mean PI was observed according to number of neurological or psychological symptoms.

The neurobehavioral tests (Fig. 2) results revealed that mean simple reaction time was 32.31 ± 7.5 seconds and choice reaction time was

66.18 ± 6.6 seconds. The tweezer and finger dexterity tests show a mean performance of 35.69 ± 9.36 and 24.91 ± 6.47 in 180 seconds time respectively. The mean error for tweezer dexterity was 2.07 ± 2.03 while that for finger dexterity was 2.06 ± 1.35. Thus the mean accuracy during tweezer dexterity was found to be 92.7 ± 9.49 % while mean accuracy for finger dexterity was 90.58 ± 7.81%. When the memory was assessed it was found that during forward recall 65 (73%) of the subjects could recall up to 4 digits while only 24 (27%) could recall 5 digits. Similarly during backward recall 80 (89.9%) could recall up to 3 digits while only 9 (10.1%) could recall 4 digits. In the digit symbol test the mean performance was 33.37 ± 14.41 in 180 seconds time. Further analysis of the neurobehavioral tests and MRI findings according to various study parameters is in progress.

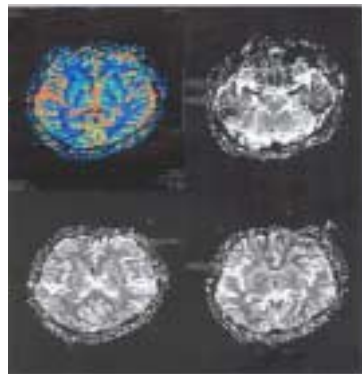


Fig. 1: MRI scan of a subject with PI of 140.3



Fig. 2: Manganese miner performing the finger dexterity test