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MEDIAN NERVE SOMATOSENSORY EVOKED POTENTIALS IN RUBBER FACTORY WORKERS

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Abstract : Somatosensory evoked potentials (SEPs) on median nerve stimulation were studied in 38 rubber factory workers to detect possible subclinical impairments in the somatosensory pathway as a result of exposure to rubber factory chemicals. Results showed trend towards the prolongation of latencies of all the major peaks of SEP such as P1, N1, P2, N2, P3, N3 in exposed workers besides changes in peak to peak amplitudes (higher P1 - N1 and lower N2 - P3). These changes may be attributed to synergistic action of solvents and other rubber factory chemicals on the generators of SEPs located higher up at the thalamo-cortical level.

Key words : somatosensory evoked potentials; median nerve; rubber factory environment; factory workers

INTRODUCTION

The manufacture of rubber products such as tyres and tubes requires use of wide variety of chemicals (approx, 500) grouped into various categories according to the purpose for utilisation (1). Many of these chemicals such as solvents are known neurotoxic agents as they readily cross the blood-brain barrier because of being nonpolar and having affinity for lipid rich tissue of brain. Long term exposure to organic solvents may cause impairment to both central and peripheral nervous system (2). Chronic and less readily noticed adverse effects caused by long term exposure to chemicals have become of primary interest in occupational medicine especially where improvements of working conditions have led to decreased prevalence of acute and severe intoxicants (3). This has necessitated the need for development of new methods which enable the early detection of neurotoxic effects of exposure to various chemicals. Neuropsycho-logical tests have not proven to be of definite value in differentiating neurotoxic disease from naturally occurring neurologic diorder as many factors can interfere with neuropsychologic evaluation of patients such as personality, cultural background, prior disease states, drug and alcohol abuse, primorbid IQ (4).

This problem is circumvented by using non-invasive electrophysiological methods such as evoked potentials. These potentials can measure effects of toxins on the central nervous system (CNS). These can provide reliable information on the integrity of the sensory pathways from the periphery to the cortex (5). Since the workers in the rubber factories are exposed to different forms of chemicals which are either used as ingredients or by products produced by various processes and reactions, a study was conducted to detect possible subclinical impairments in the somatosensory pathway using middle latency somatosensory evoked potentials This can help in localising site of impairment in CNS.

METHODS

The study was carried out on 38 male rubber

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factory workers and 11 control subjects (not exposed to rubber factory environment) in the middle age group ranging from 18–55 years. The mean duration of occupational exposure to rubber factory environment was 47.76 months (range 1 to 240 months). The subjects were brought to the neurophysiology laboratory and given adequate rest. They were explained about the purpose of the study and the technique. The median nerve somatosensory evoked potentials (SEPs) were recorded using Neuropack Machine (Nihon Kohden, Japan). Detailed methodology for recording SEP have also been published by us elsewhere (6, 7). The electric stimulation was given to right median nerve at wrist with the help of an electronic stimulator delivering a constant square wave current of 0.1 msec duration at a frequency of 2 Hz. The intensity of stimulation produced a detectable twitch of the right thumb. The evoked responses were recorded by using silver, silver chloride disc electrodes on the contralateral parietal scalp 2 cm posterior to the C3 position as per international 10-20 placement system (8). The ear electrode Al was taken as the reference as the ear lobes are relatively free from cortical electrical activities. A filter setting of 2 Hz -1 KHz and an electrode impedance of <5000 Ohm was used. 256 evoked responses were averaged by the inbuilt computer in the Evoked Potential Recorder (MEB 5200 series, Nihon Kohden, Japan).

The absolute peak latencies and amplitudes of positive potentials (P) and negative potentials (N) from 15 to 60 msecs of the application of stimuli were analysed. These values in the exposed group were compared with those of control group.

RESULTS

The physical characteristics of rubber factory workers and their comparison with control group are given in Table I. The differences between exposed and control group were found to be statistically nonsignificant. Table II and III respectively show measured values of absolute peak latencies (msec) and amplitudes (μv) of major peaks P1, N1. P2, N2, P3 and N3 in rubber factory workers and control group. There is a trend towards the prolongation of all the peak latencies in rubber factory workers. But it did not reach statistical significance. Peak to peak amplitude P1-N1 was higher in exposed group ($P<0.001$). But N2-P3 showed reduced amplitude in exposed group ($P<0.05$). Correlation coefficients of absolute peak latencies with duration of occupation, height, weight and surface area in exposed group are shown in Table IV. The latency of peak N1 (N20) indicated statistically significant ($P<0.01$) positive correlation with duration of occupation.

TABLE I : Physical characteristics of rubber factory workers (Mean ± SD) and control group.

Parameter	*Rubber factory workers*	*Control group*	*P value (group test)*
Height (cm)	162.37 ± 4.92	164.09 ± 7.33	0.502
Weight (kg)	53.33 ± 5.71	62.36 ± 13.60	0.06
Surface area (m^2)	1.56 ± 0.08	1.67 ± 0.20	0.093
Duration of occupation (months)	47.76 ± 49.78	-	-

DISCUSSION

This study was attempted primarily to detect subclinical involvement of somatosensory pathway. The neural generators of various peaks of SEP have been explained elsewhere (7).

Different components of the SEP predominantly reflect sequential activation of neural generators excited by ascending volley (9) when the median nerve proprioceptive fibres Ia and II cutaneous afferents are stimulated. The impulses from these afferent fibres ascend through the dorsal columns-leminiscus-thalamocortical system. Our results indicate trend towards prolonged latencies of all the peaks of SEP in rubber factory workers in

TABLE II: Mean and standard deviations of absolute peak latencies of SEPs in rubber factory workers and their comparison with control group.

Variable	*Rubber factory workers*	*Control group*	*P value (group t test)*
Peak latencies (msec)			
P1	16.78 ± 2.23	15.82 ± 1.77	0.193
N1	21.01 ± 2.80	19.88 ± 1.81	0.215
P2	29.17 ± 4.90	27.47 ± 4.12	0.302
N2	34.30 ± 6.58	32.31 ± 6.15	0.375
P3	43.70 ± 7.81	42.22 ± 8.86	0.593
N3	51.25 ± 8.94	48.73 ± 11.43	0.444

TABLE III: The values (Mean ± SD) of peak to peak amplitudes of SEPs in rubber factory workers and their comparison with control group.

Peak to peak amplitude (μv)	*Rubber factory workers*	*Control group*	*t value (student 't' test)*
P1 - N1	0.887 ± 0.52	0.397 ± 0.255	3.55*
N1 - P2	1.861 ± 0.993	1.632 ± 0.747	0.85
P2 - N2	0.784 ± 0.597	0.553 ± 0.589	1.0976
N2 - P3	1.228 ± 0.625	1.789 ± 0.854	2.0259**
P3 - N3	0.694 ± 0.518	0.482 ± 0.121	1.350

*P<0.001; **P < 0.05

TABLE IV: Correlation coeficient of absolute peak latencies of SEPs with duration of occupation and other physical characteristics in rubber factory workers.

Peak latencies	*Duration of occupation*	*Height*	*Weight*	*Surface area*
P1	0.4505	0.2314	−0.1645	−0.0582
N1	0.4635*	0.1723	−0.1130	−0.0382
P2	0.4597	−0.1628	−0.0901	−0.1717
N2	0.3328	−0.0565	−0.1483	−0.1752
P3	0.3248	−0.0347	0.0920	0.1163
N3	0.3206	0.0620	0.1094	0.094

*P < 0.01

comparison with the control group (Table II). The latency of peak N1 - the first cortical response to external stimulus (9, 10, 11) showed positive correlation with the duration of exposure (Table IV). The prolongation of latencies may be attributed to the synergistic neurotoxic action of solvents and other rubber factory chemicals on the SEP pathway. Main constituents of organic solvents used in making of tyres and tubes include naphtha, pentane, hexane, heptane, octane, benzene, toluene, xylene, isopropanol etc. These have been detected in ambient environment of selected work areas (12). Solvent induced changes in SEP components have been reported by several workers (3, 13-17). The studies conducted by Deschmp et al (13) on subjects exposed to organic solvents indicated longer P22 and N35 latencies and amplitude N20-P22 than control groups. There was increasing trend for N20 latency. The mean duration of exposure in that study was much higher (13.9 years) than our study (about 4 years) Table I. This perhaps be the explanation for the increasing latencies in the rubber factory environment exposed workers not reaching statistically significant level. This is further substantiated by observation of significant correlation of latency of N1 with duration of occupation (Table IV).

Similarly other studies showed prolongation of latencies of median SEP in workers exposed to n-hexane but no exposure duration indicated (14) and mixed solvents with mean duration of exposure 12 years (15). We have also found statistically significant increase in amplitude of P1N1 (Table III) besides longer latency of N20 in rubber factory workers. This increase in amplitude may be attributed to excitation due to local irritation of generators as a result of accumulation of chemicals. Mutti et al observed significant prolonged latencies of P15, N20 and N26 and higher N20 - P22 amplitude in 15 women exposed to n-hexane but the late phase (N41-N75) of cortical responses after stimulation of median nerve led to decreased amplitude (16). Our observations are in agreement with this.

The present study indicates that these SEPs whose generators are located higher up at the thalamocortical level are affected in the rubber factory workers. Hence, these observations suggest that exposure to rubber factory environment does affect the integrity of those generators and as a result show changes in latency and amplitude of various components of SEPs. But it is difficult to pin point the culprit chemical (s) responsible for these effects. Future studies involving quantitative and qualitative analysis of ambient workplace environment and their level in body fluids may throw light on possible role of these neurotoxicants in these cases.

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