MINISYMPOSIUM: PESTICIDE EXPOSURE AND THE NERVOUS SYSTEM: WHAT EVIDENCE EXISTS FOR CHRONIC AND LONG-TERM EFFECTS?

Th-O-20 MECHANISMS OF NEUROTOXICITY: AN OVERVIEW

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Background and aims: The relevant mechanism/mode of action for toxic effects on the peripheral and central nervous system will be presented. These will be discussed in terms of dose-response and dose-effect relationships.
Methods: A survey of the literature will be performed aiming at identifying the mechanisms of action and toxicity targets that may help in explaining some of the findings of the epidemiological studies. Some of the long-term outcomes will be discussed and tentatively identified as primary effects or secondary to either general toxicity, delayed or insufficient therapy.
Results: Among others, experimental data indicate that long-term effects after poisoning by organophosphorus compounds are associated with insufficient treatment of hypoxia and/or convulsions rather than due to a direct effect on acetylcholinesterase (inhibition). Other neurotoxic effect of organophosphorus compounds, apparently not related to acetylcholinesterase inhibition will also be discussed. The biological basis for the causation of parkinsonism by either paraquat or rotenone will be presented highlighting the differences between the biochemical and morphological findings in "spontaneous" Parkinson's disease.
Discussion and conclusions: It is concluded that careful consideration of the mechanism/mode of action of the neurotoxicants is a prerequiste to properly understand both results of the epidemiological studies and the findings in the individual patient.

Th-O-21 NEUROBEHAVIORAL EFFECTS OF PESTICIDES: A REVIEW OF CURRENT KNOWLEDGE

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uncertainty still persists on long term effects consequent to low dose exposure. In this field, behavior might be a specific target, and neurobehavioral effects are reported in literature, but a link between prolonged exposure to pesticides and neurobehavioral outcomes has not been firmly established or denied yet.
Methods: A literature search has been done and a total of about 110 papers have been selected, collected and evaluated. In the evaluation, it has been taken into account for each paper compound/s addressed, number of subjects studied, exposure assessment/estimation, control of confounders, type of alteration observed, types of testing methods applied, and information on the experimental design.
Results: Neurobehavioral effects consequent to severe acute intoxications are documented, but studies addressed to subjects occupationally and environmentally exposed to pesticides, in absence of previous acute intoxication, do not show univocal results, even though some evidence is available of effects in the most exposed population subgroups such as, for example, sheep dippers. An association between exposure to phenoxy herbicides and cognitive or neuropsychiatric dysfunction has been suggested in past, but not confirmed by more recent studies, and neurobehavioral changes have been observed in DDT exposed workers engaged in malaria control activities and in workers exposed to fumigants, such as methyl bromide. The main limits of existing studies are represented by the different in the approach carried out by different groups, difficulties in the selection of the study population and control of confounding factors, namely difference in the education status, lack of knowledge on exposure levels and difficulties in obtaining sound exposure estimates, and limited knowledge on the mechanism of action of the observed effects.
Discussion and conclusions: Even though no conclusion can be drawn, concern on neurobehavioral toxicity of pesticide is still high, mainly for the possible consequences on vulnerable subgroups, such ad children and pregnant women. Therefore, these groups, based on the precaution principle, have to considered specific targets for preventive measures. Further research is needed on the topic, and a specific effort for the standardization of the tests to be performed is necessary.

Th-O-23 MULTIPLE PESTICIDE EXPOSURE AND NEUROLOGICAL EFFECTS IN CHILDREN FROM AGRICULTURAL VILLAGES IN COSTA RICA

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Background and aims: The aim was to study neurological effects in children environmentally exposed to pesticides.
Methods: The study population included two villages nearby banana (large scale) and plantain (small-scale) plantations with extensive pesticide use, and one with little pesticide use (organic farmers). Parents' written informed consent was obtained for 188 children aged 6-9 (86% response rate). Cognitive, motor and sensorial tests, psycho-behavioral disorder inventories, and a clinical examination, were applied in 140 children who met inclusion criteria: 1) no history of pre-and perinatal problems, diabetes or neurological diseases (meningitis, epilepsia, motor problems), or headtrauma; 2) never repeated a school-year; 3) living more than one year in the village. Parents and children were interviewed about exposure-related factors, medical history and socio-economical aspects. For 124 children urine samples were obtained and analyzed for ETU (exposure to ethylenedithiocarbamates), TCP (chlorpyrifos), 3PBA (synthetic pyrethroids), and 2-4D, MCPA, and 245T (phenoxyacetic acids). Forty children were sampled on multiple occasions.
Results: In this moment only results for ETU are available (97%>LOD). Levels varied between communities (S2=4.4), subjects (S2=1.3), and days (S2=1.5). Levels were highest in the banana village with weekly aerial application of dithiocarbamates, median: 4.45 μg/L gravity adjusted urine, versus 1.41 μg/L (plantain) and 0.78 μg/L (organic farmers). Levels were slightly higher for boys. Geometric means of ETU-values were calculated for children with repeated measurements and used in statistical analysis. Children's report about the frequency of entering plantations with pesticide use was correlated with logtransformed ETU levels ($r=0.4$, $p<0.001$). Test outcomes were related with exposure and co-variables, using multiple regression modeling. The frequency of entering plantations was associated with cognitive test outcomes; for WISC's partial intelligence coefficient of information processing velocity ($\beta=-0.74$; $p=0.05$). Similar results were found for verbal learning capacity ($\beta= -1.14$, $p<0.05$), and immediate memory ($\beta=1-60$, $p=0.02$) assessed with California Verbal Learning Test. Logtransformed ETU levels were associated with oppositional disruptive behavior disorders in boys ($p<0.01$) assessed with Conner's teacher rating scale.
Discussion and conclusions: We conclude that children living nearby banana and plantain plantations are environmentally exposed to pesticides. The intensity of exposure is associated with cognitive effects in both girls and boys, and disruptive behavior disorders in boys.

NEUROBEHAVIORAL EFFECTS OF ENVIRONMENTAL AIRBORNE MANGANESE AND OTHER POLLUTANTS

Th-O-24 CHILD NEUROPSYCHOLOGICAL ASSESSMENT IN THE CONTEXT OF A TRANSDISCIPLINARY STUDY ON HEALTH RISK IN A MANGANESIFEROUS BASIN IN MEXICO

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Background and aims: An exploratory research project was conducted in Marietta, Ohio to test the hypothesis that 4th-grade school children would underperform matched-control school children from Athens, a town 45 miles west of Marietta in Southeastern Ohio, on tests of neurobehavioral and school performance. Impetus for the study was data from the US Environmental Protection Agency's Toxic Release Inventory database on airborne pollutant emissions. Marietta is located near the source of the highest airborne manganese release in the US, the last remaining ferro-manganese alloy plant in the country, which averaged about 450,000lbs of Mn emission per year since 1988. Four air monitoring sites set up at different sites within 4 miles of the emission point all averaged .1um/m3 for the 8 months that data was collected in 2007, and three of those sites had at least 1 month's reading at .3ug/m3.
Methods: Nineteen life-long residents of Marietta in the 4th grade were randomly selected from a pool of volunteers, and matched with 19 volunteers from Athens for grade, age, gender, ethnicity and parental education. The battery of tests administered to the students included 11 neurobehavioral tests of cognitive, sensory and motor function. In addition, a questionnaire on social skills was completed by each child's primary teacher, and scores from standardized Ohio end-of-grade tests in five subject areas were compared.
Results: The neurobehavioral tests of spelling, balance, visual contrast sensitivity and short-term memory showed significant group differences with poorer performance by the Marietta cohort. The Marietta students also scored significantly lower on the standardized tests of writing, citizenship and science.
Discussion and conclusions: These results must be viewed as tentative due to the small sample sizes, the lack of a detailed exposure assessment and other study shortcomings. However, the results suggested the need for a larger, more comprehensive study of a potential relationship between airborne manganese exposure and adverse neurological outcomes in Marietta residents