Crude Oil Vapor Neurotoxicity Study Dataset

Overview of the Project

Title:

Biological effects of inhaled crude oil vapor VI. Altered biogenic amine neurotransmitters and neural protein expression

Introduction:

In the oil and gas industry, workers are potentially exposed to crude oil or crude oil vapor (COV) during upstream (drilling and extraction), midstream (transportation and storage), as well as downstream (refining) activities. Worker exposure to various fractions of crude oil have been linked to mortality, as well as musculoskeletal, respiratory, gastrointestinal, circulatory problems, and cancer. During the Gulf of Mexico Deepwater Horizon (DWH) oil spill, response workers were exposed to a variety of chemical hazards including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), heavy metals, as well as components of the oil dispersants employed to disperse the oil. The Gulf Long-term Follow-up (GuLF) STUDY had reported that workers involved in the cleanup operations experienced adverse hematologic, pulmonary, hepatic, and cardiac problems. However, long-term neurological effects remain unknown.

Health Hazard Evaluation (HHE) surveys conducted by NIOSH among the cleanup workers identified a variety of health effects, including neurological symptoms. Unfortunately, as a significant number of response workers who experienced health symptoms were exposed to both crude oil and the oil dispersant that was aerially sprayed to the contain the spill, the health effects of crude oil exposures alone were difficult to discern from these surveys. It is here that laboratory-based studies are advantageous as they can provide ample health risk information to establish the toxicological potential of the various chemical hazards at the workplace. To that end, the present work evaluated the neurotoxic risks of COV generated from the Macondo well crude oil that was used as a surrogate for the DWH crude oil.

Methods Collection:

Animals:

- Male Sprague-Dawley [Hla:(SD) CVF] rats (200 – 250 g) were used in the study.

Whole-body inhalation exposure

- SD rats were exposed to COV (300 ppm; 6h/d) generated using Macondo well crude oil.
- To assess acute toxicity, rats were exposed for a single day (300 ppm; 6 h/d × 1 d).
- To assess long-term/repeated-dose toxicity, rats were exposed for 6 h/d × 4 d/wk × 4 consecutive wks (for a total of 16 exposure days).
- Control animals were simultaneously exposed to HEPA-filtered air.
- Exposures were conducted in two experimental blocks to obtain a final n = 8/group.

Euthanasia and sample collection

- Animals were euthanized with sodium pentobarbital euthanasia solution and exsanguinated to ensure death.
- In the acute studies, the animals were euthanized at 1 or 28 d after exposure.

- In sub-chronic studies, the animals were euthanized at 1, 28 or 90 d after exposure.
- Discrete brain regions, i.e., olfactory bulb (OB), striatum (STR) and midbrain (MB) from the left and right hemispheres were dissected free hand.
- Brain tissues from the left hemisphere were collected in 1% perchloric acid and stored at -75 °C for neurotransmitter analysis.
- Brain tissues from right hemisphere were collected in Tissue Protein Extraction Reagent and stored at -20 °C for isolation of proteins to be used in immunoblot analysis.
- Total protein was determined by micro-bicinchoninic acid (micro-BCA) method.

High performance liquid chromatography with electrochemical detection (HPLC-EC)

- Biogenic amines, norepinephrine (NE), epinephrine (EPI), dopamine (DA), and serotonin (5-hydroxytryptamine, 5-HT) were measured by HPLC-EC.
- Neurotransmitter levels were determined from the standard curves, calculated as ng/mg total protein, and are graphically represented as percent of air-exposed controls.

Sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and Western immunoblotting

- Brain proteins were separated by SDS-PAGE and transferred to PVDF membrane.
- Membranes were blocked, washed, and incubated overnight at 4 °C with the primary antibody of interest.
- After primary antibody incubation, the membranes were washed, and subsequently incubated for 1 h at room temperature with the appropriate near-infrared fluorescent dye (IRDye)-conjugated secondary antibody.
- The fluorescent signal intensities (*k* counts) of the individual protein bands were measured using the LI-COR Odyssey Imaging system and normalized to the endogenous control (Beta Actin).
- The data are graphically represented as percent of air-exposed controls.

Citation(s):

Sriram, K. Lin, G., X., Jefferson, A., M., McKinney, M., Jackson, M., C., Cumpston, J., L., Cumpston, J., B., Leonard, H., D., Kashon, M., and Fedan, J., S. 2022. Biological effects of inhaled crude oil vapor VI. Altered biogenic amine neurotransmitters and neural protein expression. *Toxicol Appl Pharmacol* [in clearance]

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