

Occupational Medicine Clinical Update

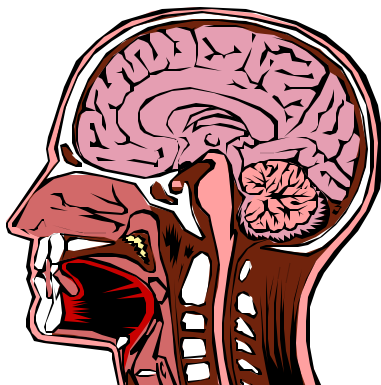
Dedicated to the prevention of occupational illness and injuries, and promoting the well-being of all workers

Occupational Health Clinics for Ontario Workers Inc, Sarnia-Lambton

Syncope in a 42-year-old Sandblaster

This Issue:

- Focus on the Organic Solvents
- Summary of major effects
- Classification and uses
- Protecting workers



A 42-year-old worker presented to the ER after an episode of syncope. He and two co-workers had been sandblasting inside a chemical storage vessel when they began to experience symptoms of giddiness and incoordination.

The workers quickly became incoherent and one lost consciousness for several minutes. In the ER, this patient was completely amnesic about the incident. He did not recognize his wife or children when they arrived.

His symptoms persisted for months, suffering from difficulty concentrating, sleep and mood disturbance, and severe memory impairment. Slowly the symptoms began to resolve, however, a year later he still had some lingering symptoms.

This case is typical of acute solvent neurotoxicity. The solvents are a vast group of compounds defined by their ability to dissolve fats, oils, waxes, paints, pigments, varnishes, rubber, and a number of other chemicals ubiquitous in our society and particularly in Sarnia's industrial complex. The general classifications of solvents are included in Table 1 below, with sources of exposure tabled on Page 2.

Most solvents have significant volatility, odour and toxicity. Because many of these substances are

organic hydrocarbons they are lipophilic and thus, commonly affect the CNS/PNS, liver and skin, although they have a wide range of effects on other organs including renal, hematologic and immune systems.

The following is a very brief summary of the main, currently recognized, effects of this huge group of compounds on major body systems.

Central Neurological Effects

Acute exposure to organic solvents can result in symptoms similar to narcotization and ultimately progress to seizures, coma and death. Symptoms can resolve if the patient is removed from the exposure, but prolonged and even permanent impairment can result.

In the case of chronic exposure, chronic toxic encephalopathy (CTE) can result. The WHO has defined three stages of solvent-induced CTE:

Type I – cognitive and constitutional symptoms, generally reversible.

Type II – symptoms and either mood disturbance (IIa) or cognitive changes (IIb).

Type III—frank dementia.

It is worth thinking about this classification in workers that present with constitutional, affective, or cognitive symptoms, for example: a spray painter with apathy and depression, or a petrochemical worker with 'bizarre behaviour' and memory problems.

Peripheral Neurological Effects

Any worker with significant exposure to solvents is at risk for peripheral neuropathies of the upper and lower extremities. These changes can be demonstrated on nerve conduction studies and EMG. Painters, in particular, have been studied a great deal in relation to these problems and should be considered at higher risk.

Various solvents have been shown to cause pathological changes in axons of the PNS and CNS (cerebral, cerebellar and spinal tracts).

Renal Effects

Short-term, high-level exposures to certain solvents can cause ATN and lead to acute renal failure. Long-term exposures to solvents are associated with glomerulonephritis.

(Continued on page 2)

Table 1 : Solvent Classifications and Some Common Examples

Classification	Solvents
Aromatics	Benzene/toluene/xylene (BTX), ethylbenzene, styrene
Aliphatic hydrocarbons	Alkanes (e.g. N-hexane), alkenes, alkynes
Alicyclic hydrocarbons	Cyclo-propane, -pentane, -hexane, -hexene, etc
Alcohols	Isopropyl alcohol, methyl alcohol, butyl alcohol
Aldehydes	Formaldehyde, acrolein
Halogenated hydrocarbons	Trichloroethylene, dichlorobenzene, tetrachloroethylene, methylchloroform, methylene chloride, ethylene dichloride
Chlorofluorocarbons	Fluorotrichloromethane, trichlorotrifluoroethane
Ethers	Diethyl ether, 1,4-dioxane
Esters	Methyl acetate, ethyl acetate, butyl acetate, vinyl acetate
Glycol derivatives	Ethyleneglycol monomethyl, ether acetate, monobutyl ether
Ketones	Acetone, methyl ethyl ketone, methyl isobutyl ketone
Petroleum distillates	Naphthas, white spirit
Miscellaneous	Carbon disulfide, tetrahydrofuran, limonene, ethylene oxide

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Table 2 : Sources of Solvent Exposure

Sources/Processes	Solvents Used
Metal degreasers	Methylene chloride, perchloroethylene 'perc', trichloroethylene (TCE), trichloroethane
Dry cleaning	'perc', TCE, trichloroethane, ethylene dichloride (EDC), mineral spirits
Paint and coating	Toluene, xylenes, acetone, methyl ethyl ketone (MEK), methyl isobutyl ketone (MIBK)
Paint stripping	MEK, methylene chloride, kerosene, mineral spirits
Manufacturing	Benzene, xylenes, styrene, chloroform, dichlorobenzene, methylene chloride, 'perc', hexane, EDC, MEK, TCE
Film development	Methylene chloride, EDC
Common household products	Toluene, xylenes, MEK, MIBK, trichloroethane, methylene chloride, dichlorobenzene, TCE
Gasoline	Benzene, toluene, xylenes (BTX), EDC, ethylene dibromide (EDB)
Fumigants	Dichlorobenzene, EDC, EDB, dichloropropane, methylene chloride, dibromo-dichloropropane (DBCP)

("Syncope" continued from Page 1)

Hepatic Effects

Halogenated hydrocarbons (carbon tetrachloride, chloroform, perchloroethylene) have been associated with hepatotoxicity. Acute and chronic hepatitis can result depending on level of exposure.

Hepatotoxic effects have also been observed with non-halogenated hydrocarbons (kerosene, hexane, xylene, styrene, toluene).

Cardiovascular Effects

Solvents cause direct and indirect cardiac effects that can result in acute and chronic cardiac toxicity. Some substances cause vasoactive phenomena (methylene chloride) while others can cause fatal arrhythmias in high doses (halogenated hydrocarbons).

Dermal and Mucous Membrane Effects

Due to their lipid dissolving properties many solvents cause severe defatting of skin resulting in dermatitis. Some solvents are potent irritants causing blistering and/or burns to both skin and mucous membranes of upper and lower respiratory tracts. Others can cause sensitization resulting in urticaria and other allergic phenomena.

Reproductive and Developmental Effects

Organic solvents have been consistently shown to be associated with a modest increase risk of birth defects, and less consistently with spontaneous abortion. They have also been linked to menstrual disorders, pre-eclampsia, and low sperm counts.

Autoimmune Disorders

Various solvents have been shown to be associated with a wide range of autoimmune disorders as well as some disorders of an autoimmune nature that are difficult to characterize. The latter have been labeled undifferentiated connective tissue disorders (UCTD).

Carcinogenicity

Benzene is considered a Group 1 carcinogen by the International Agency for Research on Cancer (IARC), causing leukemia and other hematopoietic malignancies. Bis-chloromethyl ether (BCME) and chloromethyl methyl ether (CMME) are also Group 1 carcinogens causing small cell carcinoma of the lung. They are used during manufacture of polymers, ion-exchange resins and waterproof coatings.

Vinyl chloride has been long-recognized as a cause of hepatic angiosarcoma. Other solvents suspected by IARC to be carcinogens include: trichloroethylene, tetrachloroethylene (perchloroethylene or 'perc'), ethylene dibromide (EDB), 1,2-dibromo-3-chloropropane,

ethylene dichloride (EDC), carbon tetrachloride, chloroform, and epichlorhydrin.

Occupations that expose workers to carcinogenic solvents, according to IARC, include: petroleum refining, dry cleaning, printing processes, hairdressing or barbering, and carpentry and joinery [IARC, 1998].

Coexistent Medical Conditions

Solvent exposure can also increase risk with certain medical conditions:

- Pre-existing IHD
- Alcoholism, alcoholic hepatitis
- Acute or chronic hepatitis
- Chronic cardiac arrhythmias
- Seizure disorders

In any conditions affecting the systems noted above, while examining other risk factors, it is always worth looking into the individuals occupational exposures. Solvents may be an issue.

Conclusion

This is a very brief review of the known effects of this vast group of compounds. Much is still not known due to the limitations of epidemiological studies and the huge number of compounds in use in our industrial settings. How they interact with other substances, lifestyle factors, medical and genetic conditions, and exposures in our environment, over a person's lifetime is as yet, an unanswerable question.

We do know that we are continuously related stories of workers who use solvents to wash their tools and hands, eat while wearing solvent-soaked clothing, violate safe-handling procedures and are not wearing recommended personal protective equipment (PPE). Reminding them of some of the known medical conditions associated with these substances (and that there are many effects we will not recognize for many years) and thus encouraging following proper procedures and use of PPE, may be a very effective tool as a primary prevention measure.

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