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Occupational Health

A STUDY OF OCCUPATIONAL HEALTH AND MONITORING OF CHEMICALS

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ABSTRACT This study discusses the monitoring of employee health status in the workplace. A responsible industrial operation involving hazardous substances must have an effective occupational and environmental health program to monitor workers for health effects that might result from unknown exposures to chemical or physical agents during normal operations or from accidental exposures during critical conditions. The goal of employee health monitoring is to ensure that measures to protect the employee from workplace hazards are effective by carrying out medical surveillance programs for the early detection of adverse health effects. The main goal is to prevent occupational health hazards caused due to chemicals. The types of chemical or physical hazards encountered determine the nature of the medical surveillance or health monitoring programs.

KEYWORDS : surveillance, chemicals, hazardous substances, health effects, human exposure.

INTRODUCTION

The toxicity of a substance is its ability to cause harmful effects. These effects can strike a single cell, a group of cells, an organ system, or the entire body. A toxic effect may be visible damage, or a decrease in performance or function measurable only by a test. All chemicals can cause harm. When only a very large amount of the chemical can cause damage, the chemical is considered to be practically non-toxic. When a tiny amount is harmful, the chemical is considered to be highly toxic. The toxicity of a substance depends on three factors: its chemical structure, the extent to which the substance is absorbed by the body, and the body's ability to detoxify the substance (change it into less toxic substances) and eliminate it from the body. Many chemicals have inherent properties that can negatively impact the human body and its functions. The hazards of some chemicals are extensively studied, well-understood, and have been published in the literature or in textbooks. These chemicals are assigned hazards that are communicated to the researcher through pictograms and hazard statements.

However, it is important to keep in mind that new experimental compounds and compounds that are derived from well-studied chemicals may pose unknown or unexpected health hazards and should be handled as such. If you are handling a new and untested substance, treat them as potentially harmful, and minimize any exposure through absorption, inhalation, or ingestion. The most important factor in toxicity is the chemical structure of a substance-what it is made of, what atoms and molecules it contains and how they are arranged. Substances with similar structures often cause similar health problems. However, slight differences in chemical structure can lead to large differences in the type of health effect produced. For example, silica in one form (amorphous) has little effect on health, and is allowed to be present in the workplace at relatively high levels. After it is heated, however, it turns into another form of silica (crystalline) that causes serious lung damage at levels 200 times lower than amorphous silica.

THE ROUTES OF EXPOSURE

Exposure normally occurs through inhalation, skin or eye contact, and ingestion. Inhalation The most common type of exposure occurs when you breathe a substance into the lungs. The lungs consist of branching airways (called bronchi) with clusters of tiny air sacs (called alveoli) at the ends of the airways. The alveoli absorb oxygen and other chemicals into the bloodstream. Some chemicals are irritants and cause nose or throat irritation. They may also cause discomfort, coughing, or chest pain when they are inhaled and come into contact with the bronchi (chemical bronchitis). Other chemicals may be inhaled without causing such warning symptoms, but they still can be dangerous. Sometimes a chemical is present in the air as small particles (dust or mist). Some of these particles, depending on their size, may be deposited in the bronchi and/or alveoli. Many of them may be coughed out, but others may stay in the lungs and may cause lung damage. Some particles may dissolve and be absorbed into the blood stream, and have effects elsewhere in the body.

Skin Contact: The skin is a protective barrier that helps keep foreign chemicals out of the body. However, some chemicals can easily pass through the skin and enter the bloodstream. If the skin is cut or cracked, chemicals can penetrate through the skin more easily. Also, some caustic substances, like strong acids and alkalis, can chemically burn the skin. Others can irritate the skin. Many chemicals, particularly organic solvents, dissolve the oils in the skin, leaving it dry, cracked, and susceptible to infection and absorption of other chemicals.

Eye Contact: Some chemicals may burn or irritate the eye. Occasionally they may be absorbed through the eye and enter the bloodstream. The eyes are easily harmed by chemicals, so any eye contact with chemicals should be taken as a serious incident.

Ingestion: The least common source of exposure in the workplace is swallowing chemicals. Chemicals can be ingested if they are left on hands, clothing or beard, or accidentally contaminate food, drinks or cigarettes. Chemicals present in the workplace as dust, for example, metal dusts such as lead or cadmium, are easily ingested.

THE TOXICITY OF CHEMICALS

In general, the greater the amount of a substance that enters your body, the greater is the effect on your body. This connection between amount and effect is called the “dose-response relationship”. For example, organic solvents such as toluene, acetone, and trichloroethylene all affect the brain in the same way, but to different degrees at different doses. The effects of these solvents are similar to those that result from drinking alcoholic beverages. At a low dose, you may feel nothing or a mild, sometimes pleasant ("high") sensation. A larger dose may cause dizziness or headache. With an even larger dose you may become drunk, pass out, or even stop breathing. When you inhale a toxic chemical, the dose you receive depends on four factors: (1) the level (concentration) of chemical in the air; (2) how hard (fast and deep) you are breathing, which depends on your degree of physical exertion; (3) how much of the chemical that is inhaled stays in your lungs and is absorbed into your bloodstream; and (4) how long the exposure lasts. It is safest to keep exposure to any toxic substance as low as possible. Since some chemicals are much more toxic than others, it is necessary to keep exposure to some substances lower than others. The threshold level is the lowest concentration that might produce a harmful effect. It is different for every chemical. The threshold for one chemical may differ from person to person If the concentration of a chemical in the air is kept well below the threshold level, harmful effects probably will not occur. Levels above the threshold are "too much." However, this means only that there is a possibility that health effects might occur, not that such effects definitely will occur.

DURATION OF EXPOSURE

The longer you are exposed to a chemical, the more likely you are to be affected by it. The dose is still important-at very low levels you may not experience any effects no matter how long you are exposed. At higher concentrations you may not be affected following a short-term exposure, but repeated exposure over time may cause harm. Chemical exposure which continues over a long period of time is often particularly hazardous because some chemicals can accumulate in the body or because the damage does not have a chance to be repaired. The combination of dose and duration is called the rate of exposure. The

body has several systems, most importantly the liver, kidneys and lungs, that change chemicals to a less toxic form (detoxify) and eliminate them. If your rate of exposure to a chemical exceeds the rate at which you can eliminate it, some of the chemical will accumulate in your body. For example, if you work with a chemical for eight hours each day, you have the rest of the day (16 hours) to eliminate it from your body before you are exposed again the next day. If your body can't eliminate all the chemical in 16 hours and you continue to be exposed, the amount in the body will accumulate each day you are exposed. Illness that affects the organs for detoxification and elimination, such as hepatitis (inflammation of the liver), can also decrease their ability to eliminate chemicals from the body. Accumulation does not continue indefinitely. There is a point where the amount in the body reaches a maximum and remains the same as long as your exposure remains the same. This point will be different for each chemical. Some chemicals, such as ammonia and formaldehyde, leave the body quickly and do not accumulate at all. Other chemicals are stored in the body for long periods. For instance, lead is stored in the bone, calcium is stored in the liver and kidneys, and polychlorinated biphenyls (PCBs) are stored in body fat. There are a few substances, such as asbestos fibers, that, once deposited, remain in the body forever.

The effects of toxic substances may appear immediately or soon after exposure, or they may take many years to appear. Acute exposure is a single exposure or a few exposures. Acute effects are those which occur following acute exposures. Acute effects can occur immediately, or be delayed and occur days or weeks after exposure. Chronic exposure is repeated exposure that occurs over months and years. Chronic effects are those which occur following chronic exposures, and so are always delayed. A toxic chemical may cause acute effects, chronic effects or both. For example, if you inhale solvents on the job, you may experience acute effects such as headaches and dizziness which go away at the end of the day. Over months, you may begin to develop chronic effects such as liver and kidney damage. The delay between the beginning of exposure and the appearance of disease caused by that exposure is called the “latency period”. Some chronic effects caused by chemicals, such as cancer, have very long latency periods. Cancer has been known to develop as long as 40 years after a worker's first exposure to a cancer-causing chemical. The length of the latency period for chronic effects makes it difficult to establish the cause-and-effect relationship between the exposure and the illness. Since chronic diseases develop gradually, you may have the disease for some time before it is detected. It is, therefore, important for you and your physician to know what chronic effects might be caused by the substances you use on the job.

REACTION AND INTERACTION

Depending upon the job you have, you may be exposed to more than one chemical. If you are, you need to be aware of possible reactions and interactions between them. A reaction occurs when chemicals combine with each other to produce a new substance. The new substance may have properties different from those of the original substances, and it could be more hazardous. For example, when household bleach and lye (such as a drain cleaner) are mixed together, highly dangerous chlorine gas and hydrochloric acid are formed. The Material Safety Data Sheet (MSDS) for a chemical will often list its potential hazardous reactions and the substances which should not be mixed with it. An employer is required by law to have an MSDS for each hazardous substance in the workplace, and make them available for employees on request. An interaction occurs when exposure to more than one substance results in a health effect different from the effects of either one alone. One kind of interaction is called synergism, a process in which two or more chemicals produce an effect that is greater than the sum of their individual effects. For instance, carbon tetrachloride and ethanol (drinking alcohol) are both toxic to the liver. If you are overexposed to carbon tetrachloride and drink alcohol excessively, the damage to your liver may be much greater than the effects of the two chemicals added together.

MEASURING AND MONITORING

When toxic chemicals are present in the workplace, your exposure can be determined by measuring the concentration of a given chemical in the air and the duration of exposure. This measurement is called air or environmental monitoring or sampling and is usually done by industrial hygienists, using various types of instruments. The air is collected from your breathing zone (the air around your nose and mouth) so that the concentrations measured will accurately reflect the concentration you are inhaling. The exposure levels calculated from this monitoring can then be compared to the Permissible Exposure Limit (PEL) for that chemical. Environmental monitoring is the most accurate way to determine your exposure to most chemicals. However, for chemicals that are absorbed by routes other than inhalation, such as through the skin and by ingestion, air monitoring may underestimate the amount of chemical you absorb. For these and some other chemicals, the levels of the chemical (or its breakdown products) in the body can sometimes be measured in the blood, urine or exhaled air. Such testing is called biological monitoring, and the results may give an estimate of the actual dose absorbed into the body.

REDUCTION OF EXPOSURE

Everyone who works with toxic substances should know the names, toxicity and other hazards of the substances they use. Employers are required by law to provide this information, along with training in how to use toxic substances safely. A worker may obtain information about a chemical's composition, physical characteristics, and toxicity from the Material Safety Data Sheet (MSDS). WISHA regulations, require manufacturers to supply an MSDS for -products that contain certain toxic substances. Employers obtain the MSDS when they purchase the product and must make the MSDS available to employees.

Limiting exposure at the source is the preferred way to protect workers. The types of engineering controls, in order of effectiveness, are: Substitution is using a less hazardous substance. But before choosing a substitute, carefully consider its physical and health hazards. For example, mineral spirits (Stoddard Solvent) are less of a health hazard than perchloroethylene for dry cleaning, but is more of a fire hazard and an air pollutant. Process or equipment enclosure is the isolation of the source of exposure, often through automation. This completely eliminates the routine exposure of workers. For example, handling of radioactive materials is often done by mechanical arms or robots. Local exhaust ventilation is a hood or air intake at or over the source of exposure to capture or draw contaminated air from its source before it spreads into the room and into your breathing zone. General or dilution ventilation is continual replacement and circulation of fresh air sufficient to keep concentrations of toxic substances diluted below hazardous levels. However, concentrations will be highest near the source, and overexposure may occur in this area. If the dilution air is not well mixed with the room air, pockets of high concentrations may exist.

Personal protective equipment (respirators, gloves, googles, aprons) should be used only when engineering controls are not possible or are not sufficient to reduce exposure. Respiratory protective equipment consists of devices that cover the mouth and nose to prevent substances in the air from being inhaled. A respirator is effective only when used as part of a comprehensive program established by the employer, which includes measurement of concentrations of all hazardous substances, selection of the proper respirator, training the worker in its proper use, fitting of the respirator to the worker, maintenance, and replacement of parts when necessary. Protective clothing includes gloves, aprons, goggles, boots, face shields, and any other materials worn as protection. It should be made of material designed to resist penetration by the particular chemical being used. Such material may be called impervious to that 15chemical. The manufacturer of the protective clothing usually can provide some information regarding the substances that are effectively blocked.

CONCLUSIONS

Employees need to pay attention to safety training and apply what they learn on the job. When they come to a training session or safety meeting, they should be prepared to focus all their attention on participating and learning. Employees who work with hazardous materials must be thoroughly familiar with labels and MSDS, including the technical terms, warning words, pictograms, color-coding and numerical systems, etc. Workers should always read the label and MSDS prior to using any hazardous chemical in order to determine the proper PPE to use to protect against the specific hazards of the substance. Workers should be taught to don, remove, and dispose of PPE properly as well as to inspect it before use to make sure it fits correctly. Employees should inspect chemical containers regularly and report leaks or missing or unreadable labels. They should remove from the primary container only as much of a substance as they need for a job, and keep containers closed when not in use. Employees should use required ventilation to remove chemical vapors. They must store and use chemicals away from substances and conditions that could cause hazardous reactions.

REFERENCES:

[1] Guo YL, Yu M-L, Hsu C-C, Rogan WJ. Chloracne, goiter, arthritis, and anemia after polychlorinated biphenyl poisoning: 14-year follow-up of the Taiwan Yucheng cohort. Environ Health Perspect 107:715–719 (1999).

[2] Needleman H, Gunnoe C, Leviton A Peresie H, Maher C, Barret P. Deficits in psychological and classroom performance of children with elevated dentine lead levels. N Engl J Med 300:689–695 (1979).

[3] Needleman H, Schell A, Bellinger D, Leviton A, Allred E. The long-term effects of exposure to low doses of lead in childhood: an 11-year follow-up report. N Engl J Med 322:83–88 (1990).

[4] Rogan WJ, Dietrich KN, Ware JH, Dockery DW, Salganik M, Radcliffe J, Jones RL, Ragan NB, Chisolm JJ, Rhoads GG. Treatment of Lead-Exposed Children Trial Group. The effect of chelation therapy with succimr on neuropsychological development in children exposed to lead. N Engl J Med 344:1470–1471 (2001).

[5] Chen Y-C, Guo Y-L, Hsu C-C, Rogan WJ. Cognitive development of Yu-Cheng ("oil disease") children prenatally exposed to heat-degraded PCBs. JAMA 268:3213–3218 (1992).

[6] Yu M-LM, Hsu C-C, Guo YL, Lai T-J, Chen S-J, Luo J-M. Disordered behavior in the early-born Taiwan Yucheng children. Chemosphere 29:2413–2422 (1994).

[7] Jacobsen JL, Jacobson SW. Intellectual impairment in children exposed to polychlorinated biphenyls in utero. N Engl J Med 335:783–789 (1996).

[8] Stewart P, Reihman J, Lonky E, Darvill T, Pagano J. Prenatal PCB exposure and neonatal behavioral assessment scale (NBAS) performance. Neurotoxicol Teratol 22:21–29 (2000).

[9] Rogan WJ, Gladen BC. Neurotoxicology of PCBs and related compounds. Neurotoxicology 13:27–35 (1992). 29. Clarkson TW. Methylmercury toxicity to the mature and developing nervous system: possible mechanisms. In: Biological Aspects of Metals and Metal-Related Diseases (Sarkar B, ed). New York:Raven Press, 1983;183–197.

[10] Davidson PW, Myers GJ, Shamlaye C, Cox C, Gao P, Axtell C, Morris D, Sloane-Reeves J, Cernichiari E, et al. Association between prenatal exposure to methylmercury and developmental outcomes in Seychellois children: effect modification by social and environmental factors. Neurotoxicology 20:833–842 (1999).