Hearing Loss in the Workplace: Noise Exposure and Toluene

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Had Harvey Lillard been a factory worker, D.D. Palmer may have inquired not only about his upper spinal injury, but also the noise exposure Lillard had to endure as a component of his work activity. This aspect of his history gathering would be reasonable in any modern clinical encounter, since premature hearing loss has long been an established outcome from prolonged noise exposure in the workplace. In addition, had such dangers existed at that time, conscientious Palmer may have also inquired as to how much Lillard’s work activities exposed him to the popular industrial solvent toluene.

My Personal Wake-Up Call

My first awareness of this potential correlation came to me in 2007 as the result of the careful evaluation of the needs assessment data provided to me by the management of a Midwestern manufacturing firm. They had requested my assistance in helping them reduce their work-related illness and injury rate, and just as I would have for any other firm, my consultation services began with a careful analysis of their loss experience over the previous three years. Through the assessment process, I discovered that seven workers had filed a workers’ compensation claim for hearing loss during that three-year time-frame.

The company consisted of 390 employees, with approximately two-thirds of the workers engaged in activities involving noise exposure. In spite of the significant noise exposure, seven workers filing a workers’ compensation claim for hearing loss seemed excessive when compared to similar loss source analysis evaluations of other workplace facilities I had conducted, and caused me to begin a deeper investigation as to likely causes of hearing loss outside of noise exposure. These claim numbers seemed especially excessive since the workers at this firm were subjected to a zero-tolerance requirement for hearing protection when working in high-noise-exposure locations within the plant.

Toluene and Hearing Loss

For the past several decades, public health investigators have made anecdotal correlations between hearing loss and exposure to varying levels of toluene, and in 1983, Pryor, et al., 1 and Rebert, et al., were the first to explore and verify this effect in animal studies. Until recently, however, a clear association between
Toluene exposure and hearing loss in humans was inconclusive. Then in 2006, Chang and colleagues\textsuperscript{3} studied hearing loss in workers at a Taiwanese adhesive materials manufacturing site where toluene was used as a solvent. For the first time in the established literature on the topic, findings revealed the association to be much more clearly established - so much so, in fact, that the risk of hearing loss by toluene exposure may be more than \textit{six times} greater than the risk induced by noise alone.

Also of interest is that workers with the lowest toluene exposure had only a slightly lower risk of hearing loss when compared with those with higher levels of toluene exposure. The implication is that minimal exposure to toluene, both in concentration and duration, may be damaging to human hearing.

Readers are urged to take a careful look at this study, recognizing that the authors acknowledge several limitations: a relatively small sample size (n=58 in each group); their inability to measure exposure to high levels of toluene over a long work history; and the lack of available data for estimating hearing loss caused by toluene exposure alone, as both the control and the intervention group had a high level of exposure to noise. However, in spite of its acknowledged weaknesses, the authors concluded that their study does suggest workers face a greater risk of hearing loss when simultaneously exposed to toluene and noise compared to exposure to noise alone.

\textbf{Other Health Consequences}

Toluene is a clear, colorless, flammable liquid naturally found in petroleum. Exposure can come from ingestion through the G.I. tract, inhalation and skin contact. Depending upon duration and concentration, the most significant health hazards of toluene exposure in humans are disturbances within the central nervous system. Common neurologic symptoms are headache, sleepiness, fatigue, vertigo, numbness, mild nausea, memory loss and symptoms similar to drunkenness. At high levels, toluene inhalation can result in mental confusion and disturbance of coordination. In very high concentrations, such as 10,000 ppm, toluene exposure may result in unconsciousness and can be fatal.

Inhalation of toluene vapors can result in eye, nose and throat irritation. Skin contact can result in dermatitis and dry skin. Prolonged exposure to high concentrations of toluene can result in kidney and liver damage.

Common over-the-counter medications such as aspirin and acetaminophen (Tylenol, Excedrin, etc.), as well as alcohol, consumed during exposure to toluene, can enhance its negative effects. The worst effects occur in individuals who deliberately abuse toluene (glue sniffing).
**Workers and Occupations Most at Risk**

Individuals at risk for toluene exposure include those employed in the manufacture or continuous use of gasoline, kerosene, paints, lacquers, adhesives, ink, TNT, polyurethane foam, silicone sealants, rubber and rubber products, disinfectants, printer’s ink, stain removers, and nail polish, and in all occupations where toluene is used as a solvent, such as leather tanning and making coke from coal.

Toluene is also used in the process of removal of cocaine from coca leaves in the production of Coca-Cola syrup. Toluene is also found in cigarette smoke. Workers and others exposed to car and other motorized vehicle exhaust fumes can also suffer the negative effects of toluene.

**An Important Workplace Safety and Health Issue**

The National Institute for Occupational Safety and Health (NIOSH) and the occupational health community have named hearing loss one of the 21 common priority areas for research in the next century.\(^4\) Noise-induced hearing loss is completely preventable by removing the identified noise source, and significantly decreased by proper use of personal protective equipment (PPE). All possible engineering control measures should be incorporated to create quieter work environments and the alteration or enclosure of equipment, and use of sound-absorbing materials designed to reduce noise at its source.

With the new evidence indicating toluene’s ototoxicity with resultant harmful effects on human hearing, extra precaution is in order among workers who are exposed to hazardous noise environments. In such environments, a zero-tolerance policy regarding the use of hearing protection devices should be incorporated.

Doctors of chiropractic and health care providers of all disciplines must be attentive to the health risks of toluene exposure and its presenting symptoms. Such practice always begins with a comprehensive history with due emphasis on occupational exposure factors. Since chiropractors commonly encounter patients with a wide variety of central nervous system symptoms including hearing loss, special attention must be given to patients whose history indicates a potential toxic exposure from their workplace.

**References**


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