Applied pressure alters circulating hormone levels and biomarkers of peripheral vascular, sensorineural dysfunction

Workers that regularly use vibrating hand tools as part of their job are at risk of developing hand-arm vibration syndrome (HAVS). HAVS is characterized by cold-induced vasospasms that result in blanching of the fingers and hands, loss of sensation, pain, and reductions in manual dexterity, all of which can affect a worker's ability to perform their job and their quality of life. Vibration exposure significantly contributes to the development of these symptoms by increasing the stress and strain within exposed tissues, which in turn can affect functioning of blood vessels, nerves and sensory receptors in those tissues.

The International Standards Organization (ISO) standard 5349 provides guidance to help employers and workers predict if workers are at risk of developing HAVS. To date, most of the data presented in the standard have focused specifically on the effects of vibration. However, the standard states that other risk factors are likely to contribute, such as the force applied to exposed tissues when a worker is using a hand-tool, the posture of the worker, the environment the worker is working in, and various other personal health-related factors.

The goal of this study was to characterize the effects of applied force, and applied force plus vibration on vascular and sensorineural function. The rat-tail model for studying force and vibration, established at NIOSH, was used in this study. The effects of 10 days of exposure to 2 or 4N of applied force on circulating hormone concentrations, transcript expression, immunostaining for various markers of oxidative stress, growth and remodeling, and tissue morphology to determine what the effects of applied force are on exposed skin, arteries, nerves, and other tissues involved in sensorineural function including the dorsal root ganglia (DRG) and spinal cord.

Methods.

Male (n=18) Sprague-Dawley rats (Hla®(SD)CVF®, approximate body weight of 200 – 230 g at arrival), were obtained from Hilltop Lab Animals, Inc. (Scottdale, PA). After acclimation, the tails of rats were exposed to 2 or 4N of applied force or to restraint control for 4 h/day for 10 consecutive days. The morning following the last exposure, rats were anesthetized using 100-300 mg/kg sodium pentobarbital euthanasia solution and exsanguinated by cardiac puncture. Serum was collected for hormone assays and the ventral tail skin, artery and nerve, dorsal root ganglia and lumbar spinal cord were collected for histology and measurement of transcript levels. The use of animals, housing, exposures, and all other procedures performed were reviewed and approved by the Institutional Animal Care and Use Committee and are in compliance with the Public Health Service Policy on Humane Care and Use of Laboratory Animals and the NIH Guide for the Care and Use of Laboratory Animals.

Citations-Publications based on this dataset:

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