Vibration Injury Network

Research Network on Detection and Prevention of Injuries due to Occupational Vibration Exposures

Response of finger circulation to energy equivalent combinations of magnitude and duration of vibration

Appendix H3H to Final Report

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Bovenzi M, Lindsell CJ, Griffin MJ (2001) Response of finger circulation to energy equivalent combinations of magnitude and duration of vibration. *Occupational & Environmental Medicine*, **58**, 185-193.

OBJECTIVES

To investigate the acute response of finger circulation to vibration with different combinations of magnitude and duration but with the same "energy equivalent" acceleration magnitude according to current standards for hand transmitted vibration.

METHODS

Finger skin temperature (FST) and finger blood flow (FBF) were measured in the middle fingers of both hands of 10 healthy men who had not used hand held vibrating tools regularly. With a static load of 10 N, the right hand was exposed to 125 Hz vibration with the following unweighted root mean square (rms) acceleration magnitudes and durations of exposure: 44 m/s^2 for 30 minutes; 62 m/s^2 for 15 minutes; 88 m/s^2 for 7.5 minutes; 125 m/s^2 for 3.75 minutes; and 176 m/s^2 for 1.88 minutes. These vibration exposures produce the same 8 hour energy equivalent frequency weighted acceleration magnitude (~1.4 m/s^2 rms) according to international standard ISO 5349 (1986). Finger circulation was measured in both the right (vibrated) and the left (non-vibrated) middle fingers before application of the vibration, and at fixed intervals during exposure to vibration and during a 45 minute recovery period.

RESULTS

The FST did not change during exposure to vibration, whereas vibration with any combination of acceleration magnitude and duration produced significant percentage reductions in the FBF of the vibrated finger compared with the FBF before exposure (from 40.1% (95% confidence interval (95% CI) 24.3% to 57.2%) to 61.4% (95% CI 45.0% to 77.8%). The reduction in FBF during vibration was stronger in the vibrated finger than in the non-vibrated finger. Across the five experimental conditions, the various vibration stimuli caused a similar degree of vasoconstriction in the vibrated finger during exposure to vibration. There was a progressive decrease in the FBF of both fingers after the end of exposure to vibration with acceleration magnitudes of 44 m/s^2 for 30 minutes and 62 m/s^2 for 15 minutes. Significant vasoconstrictor after effects were not found in either finger after exposure to any of the other vibration stimuli with greater acceleration magnitudes for shorter durations.

CONCLUSIONS

For the range of vibration magnitudes investigated (44 to 176 m/s^2 rms unweighted; 5.5 to 22 m/s^2 rms when frequency weighted according to ISO 5349), the vasoconstriction during exposure to 125 Hz vibration was independent of vibration magnitude. The after effect of vibration was different for stimuli with the same energy equivalent acceleration, with greater effects after longer durations of exposure. The energy equivalent acceleration therefore failed to predict the acute effects of vibration both during and after exposure to vibration. Both central and local vasoregulatory mechanisms are likely to be involved in the response of finger circulation to acute exposures to 125 Hz vibration.