CLINICAL ASSESSMENT OF HAVS: CONTROVERSIES IN DIAGNOSIS AND MEASUREMENT

Ron House [1,2] and Aaron Thompson [1,2]
[1] Department of Medicine, Division of Occupational Medicine, University of Toronto
[2] Department of Occupational and Environmental Health, St. Michael's Hospital, Toronto

1. INTRODUCTION

The clinical assessment of workers to diagnose Hand-Arm Vibration Syndrome (HAVS) presents numerous challenges, especially in the context of compensation or litigation. There is controversy about the specific health effects due to hand-arm vibration and how these effects should be evaluated and measured for diagnostic purposes. In this paper, we discuss the health effects due to hand-arm vibration and their measurement.

2. METHOD

The information presented is based on our clinical experience in assessing HAVS patients at the Occupational Health Clinic, St. Michael's Hospital, Toronto. This clinic has the largest volume of HAVS patients in Canada (approximately 350 per year) and provides comprehensive HAVS assessments, often for compensation purposes. Our clinical experience has been supplemented by a literature review using Medline and Google Scholar, and the prior development of a discussion paper on this topic for the Workplace Safety and Insurance Appeals Tribunal (WSIAT) in Ontario (House, 2010).

3. RESULTS

The principal health effects associated with vibrating tools are summarized in Table 1. The use of vibrating tools results in exposure to various ergonomic stresses as well as hand-arm vibration. Therefore, this table includes a broad list of health effects, only some of which are clearly related to vibration.

3.1. Health Effects Definitely Related to Vibration

Raynaud's phenomenon in the exposed fingers is the effect most clearly related to hand-arm vibration exposure, and the evidence of a causal association for this effect is strong. As well, there is good evidence that digital sensory neuropathy occurs due to hand-arm vibration exposure. However, after consideration of these two key outcomes, the evidence for other outcomes being due to hand-arm vibration is less definitive.

3.2. Other Health Effects Possibly Related to Vibration

There is evidence that suggests that Raynaud's phenomenon may also develop in the feet in workers with HAVS (Schweigert, 2002). The key predictor of vasospasm in the feet appears to be vasospasm in the hands, with the hand effects presumably developing first. Generalized stimulation of the sympathetic nervous system is thought to be a likely mechanism, although other factors may play a role, such as systemic release of the vasoconstrictor endothelin 1 from damaged endothelial cells. Thrombi may occur in the hands of workers using vibrating tools (Thompson and House, 2006). This mainly affects the ulnar artery but may also affect the radial and digital arteries. Forceful striking with the hand (i.e. hypothenar hammer syndrome) is also a risk factor and it is not clear if the thrombi reported in workers using vibrating tools are due to work practices involving forceful hand striking or some aspect of vibration exposure, such as the impulsivity or dominant frequency.

The Stockholm sensorineural HAVS classification is based on digital sensory neuropathy and does not include carpal tunnel syndrome (CTS) due to median nerve compression at the wrist. However, neuropathy proximal to the hands including CTS and ulnar neuropathy are common in workers being assessed for HAVS. Although ergonomic stressors, in particular, forceful, repetitive flexion and extension of the wrist appear to be stronger risk factors for CTS, there is increasing evidence that hand-arm vibration may also be a risk factor for CTS (Palmer et al, 2007).

There is epidemiologic evidence suggesting that various musculoskeletal outcomes may be associated with hand-arm vibration exposure. A comprehensive review by Hagberg (2002) found that the evidence that hand-arm vibration was a risk factor for specific musculoskeletal outcomes was weak, although there was stronger evidence for work with vibrating tools and the associated ergonomic factors and/or work practices.

3.3. Measurement and Evaluation of Health Effects

A medical and occupational history and focused examination are essential. Blood tests are needed to rule out other common causes of vascular symptoms, such as collagen vascular disease, and neurological symptoms, such as diabetes mellitus. There is no single diagnostic test and a test battery is preferred with the overall results being interpreted by a physician experienced in HAVS diagnosis.

The history of the frequency and severity of finger blanching is often imprecise and should be supplemented by objective tests of cold-induced vasospasm. The most commonly used tests are plethysmography and thermometry/thermography. However, there is variation in

test technique reported in the literature, including the temperature and duration of cold water immersion and the timing of measurements after cold exposure. Measurement of hand thrombi requires an arteriogram which should only be done if clinically indicated.

Table 1. Health Effects Associated with Vibrating Tools

Category	Specific Effects
Vascular	Raynaud's phenomenon
	-Hands **
	- Feet
	Thrombi in hands
Neurological	Digital sensory neuropathy **
	Proximal neuropathies
	- Carpal Tunnel Syndrome
	- Ulnar neuropathy
Musculoskeletal	Decreased Grip Strength
	Duputyren's contracture
	Bone cysts
	Osteoporosis - hand, wrist
	Osteoarthritis – wrist, elbow, shoulder
	Upper extremity pain

** Definitely recognized to be due to hand-arm vibration.

The measurement of digital sensory neuropathy is difficult, because conventional electrode placement does not allow measurement in the distal parts of the fingers that are initially affected by hand-arm vibration exposure. Segmental or fractionated nerve conduction with electrode placement in the distal parts of the fingers is possible, but presents technical challenges including the control of finger temperature that may also affect the measured nerve conduction. Quantitative sensory tests, in particular vibration perception threshold (VPT) and current perception threshold (CPT) are better predictors than conventional nerve conduction tests of the Stockholm sensorineural scale, and present an alternative to fractionated nerve conduction. However, the neurological assessment should also include conventional nerve conduction testing to detect common co-morbid neuropathies proximal to the hand, in particular CTS, which may affect the attribution of neurological symptoms to hand-arm vibration.

Assessment of musculoskeletal abnormalities associated with the use of vibrating tools requires a thorough examination of the upper extremities and other tests, such as x-rays, CT scan, MRI, bone density measurement, as indicated by the history and examination. These tests should not be part of a standard battery. However, grip and pinch strength are helpful to measure impairment in hand strength, and the Purdue pegboard is a useful test of fine motor hand function; these tests could be included in a standardized battery.

4. DISCUSSION

Ordinarily, symptoms of numbness and tingling in the fingers and cold-induced finger blanching, which are common, might not prompt a physician to do detailed objective tests, aside from possibly nerve conduction. However, compensation by a workers' compensation board or litigation in the courts requires more objective proof of disease and it is this context which often drives the detailed testing in the assessment of HAVS patients. In the absence of an agreed upon protocol or clinical guideline, this is a recipe for controversy and disagreement.

This controversy can be reduced, if not resolved, by an evidenced-based determination of the key outcomes associated with hand-arm vibration and the best methods to measure and evaluate them. The outcomes clearly associated with hand-arm vibration include Raynaud's phenomenon and digital sensory neuropathy. These should form the basis of a case definition of HAVS for clinical assessment purposes. In the selection of diagnostic tests, it should be borne in mind that no test is definitive and a battery of tests is required. The interpretation should be informed by the sensitivity and specificity of the tests for their intended diagnostic purposes. Key competing diagnoses, in particular CTS, need to be carefully evaluated. Given the plethora of data obtained, the judgment of an experienced physician is required and the process is not easily reducible to a simple algorithm (Pelmear, 2003).

REFERENCES

Hagberg, M. (2002). "Clinical assessment of musculoskeletal disorders in workers exposed to hand-arm vibration," Int. Arch. Occup. Environ. Health, **75**, 97-105.

House, R. (2010). *Hand-Arm Vibration Syndrome*. Discussion paper prepared for the Workplace Safety and Insurance Appeals Tribunal. http://www.wsiat.on.ca/english/mlo/havs.htm

Palmer, K. T., Harris, E. C., and Coggon, D. (2007). "Carpal tunnel syndrome and its relation to occupation: A systematic review," Occup. Med. (Lond), **57**, 57-66.

Pelmear, P. L. (2003). "The clinical assessment of hand-arm vibration syndrome," Occup. Med. (Lond), **53**, 337-341.

Schweigert, M. (2002). "The relationship between hand-arm vibration and lower extremity clinical manifestations: A review of the literature," Int. Arch. Occup. Environ. Health, **75**, 179-185.

Thompson, A., and House, R. (2006). "Hand-arm vibration syndrome with concomitant arterial thrombosis in the hands," Occup. Med. (Lond), **56**, 317-321.