HAND-ARM VIBRATION WORKSHOP

November 27-28, 2006

PARTICIPANTS:
Ron House (Chair), Paul Asselin, Lori Brown, Derrick Chung, Hal De Lair, Leon Genosove, Stuart Hutchison, Tom Jetzer, Irena Kudla, Ed Lehtinen, Gary Liss, Michael Manno, Gyl Midroni, Jalees Razavi, Paul Sampara, Michael Schweigert, Sharon Switzer-McIntyre, Ihor Taraschuk, Aaron Thompson. Alice Turcot, Michael Wills, Roland Wong, Sami Youakim, Janet Brown, Nancy Mesa, Maria Wowk, Linn Holness

Funding:

1. Workplace Safety and Insurance Board (WSIB)
2. Centre for Research Expertise in Occupational Disease (CREOD)

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Research that makes a Difference

HAND-ARM VIBRATION WORKSHOP
Agenda

University of Toronto – Munk Centre for International Studies
Vivian & David Campbell Conference Facility
November 27-28, 2006

This Workshop was dedicated to the memory of Dr. Peter Pelmear

Monday November 27, 2006

8:00 Registration and Continental Breakfast
8:30 Welcome
- Ron House – introductions, review of agenda

9:00 HAVS: Overview of Canadian Context
- Canadian compensation experience - Ihor Taraschuk – 30 minutes
- *Questions and discussion – 15 minutes*
- Canadian Legislation – Leon Genesove – 30 minutes
- *Questions and discussion – 15 minutes*

Break 10:30-10:45

10:45 HAVS: Overview of Assessment
- Exposure Assessment for Hand-Arm Vibration Syndrome (HAVS) – Paul Sampara & Derrick Chung – 30 minutes
- *Questions and discussion – 15 minutes*
- Clinical Overview – Ron House – 30 minutes
- *Questions and discussion – 15 minutes*

Lunch 12:15-1:15

1:15 HAVS: Specific Clinical Aspects
- Neurological – Gyl Midroni – 30 minutes
- *Questions and discussion – 15 minutes*
- Vascular – Stuart Hutchison – 30 minutes
- *Questions and discussion – 15 minutes*
- Musculoskeletal – Roland Wong – 30 minutes
- *Questions and discussion – 15 minutes*

Break 3:30-3:45

3:45 Group Discussion – Controversial issues
- Classification of HAVS
- HAVS Assessment Methods
- HAVS Research Priorities

Wine and Cheese reception 5:30-7:00

Tuesday November 28, 2006

8:00 Continental Breakfast
8:30 Consensus & recommendations
- Canadian Classification System for HAVS
- Clinical Assessment Methods
- Research Agenda

Break 9:30-10:00

10:00 Knowledge Transfer and Exchange (KTE)
- KTE Methodology – Janet Brown – 45 minutes
- *Questions and discussion – 15 minutes*

11:00 Discussion: Application of KTE to HAVS
12:00 Next steps and closing remarks

Lunch 12:30-1:30

UNIVERSITY OF TORONTO

St. Michael's
Inspired Care.
Inspiring Science.

223 College Street
Toronto, Ontario
M5T 1R4

T: [416] 978 5883
F: [416] 978 2608
www.utoronto.ca/creod

HAND-ARM VIBRATION WORKSHOP

CANADIAN HAV WORKSHOP: SUMMARY OF PRINCIPAL FINDINGS AND RECOMMENDATIONS

1. Introduction

Hand-arm vibration syndrome (HAVS) has received little attention in Canada in the past. In particular it has not been a major focus of clinical activity, research or preventive efforts. An invited workshop was held in Toronto, Ontario on November 27, 28, 2006 to address this problem by bringing together individuals from various parts of the country to discuss current knowledge of HAVS and to develop recommendations for improved recognition of HAVS and the risks associated with exposure to hand-arm vibration (HAV).

The objectives of the workshop were as follows:

(1) To determine the recent compensation board experience for HAVS and current legislation for HAV in all of the Canadian provinces and territories.
(2) To determine the sites and methods for assessment of HAVS in Canada
(3) To review the classification and assessment methods for HAVS
(4) To recommend areas of research priority for HAVS in Canada

2. Participants and Process

The 27 participants came from backgrounds in medicine, nursing, physiotherapy, occupational hygiene, health administration and related disciplines. They included clinicians involved in assessment of HAVS patients - occupational medicine specialists as well as a neurologist and a cardiologist with expertise in assessment of peripheral nerve function and the peripheral circulation respectively. The other participants came from backgrounds in government and provincial compensation boards, universities and industry. The process consisted of a series of short presentations followed by detailed discussion to achieve consensus.

3. Findings

(a) Legislation

The review of legislation indicated that only British Columbia and New Brunswick have regulations that specifically address vibration exposure. These regulations reference the American Conference of Governmental Industrial Hygienists' TLV for hand-arm vibration. All of the other provinces have a general duty clause that could be used to reference acceptable vibration standards from other jurisdictions for implementation in a specific company being audited. However this general duty clause is seldom, if ever applied to vibration exposure in Canada.

The review of legislation in Canada indicated that HAV has not been a legislative priority in Canada in contrast to Europe and the U.K. where new standards have been adopted recently. There is a need for educational programs and improved knowledge transfer and exchange (KTE) to improve recognition of HAVS and the hazards of HAV in Canada.

(b) Compensation

The period 2000-2002 was chosen for review of compensation claims throughout Canada. The 2002 date was chosen because this was a date when all claims had been finalized but still represented recent experience. The compensation boards in all of the 10 provinces and three territories were asked to provide information about HAVS claims. The data obtained are presented in table 1.

Table 1. HAVS Compensation Claims in Canada (2000-2002)

Province	Allowed	Rejected	Total
British Columbia	78	37	115
Saskatchewan	3	1	4
Manitoba	4	4	8
Ontario	291	140	431
Quebec	103	32	135
NWT & Nunavut	9	1	10
Overall	488	215	703

Alberta, New Brunswick, Nova Scotia, Newfoundland – unable to identify specific HAVS claims

Prince Edward Island, Yukon did not respond to the request for information

There was a total of 703 HAVS claims identified in Canada during this period and 488 (69.4%) of these had been accepted. The largest number of accepted claims was in Ontario (291) followed by Quebec (103) and British Columbia (78). The average number of accepted claims per year was only 163 in the entire country with 59.6% of these occurring in Ontario.

The data from the compensation boards throughout Canada indicated that HAVS has not been commonly compensated in the past. However Canada is a relatively large industrialized country (pop. 32 million) with many primary and secondary industries resulting in vibration exposure. It is likely that there has been considerable under-recognition and under-reporting of HAVS in the country.

(c) Sites and Methods of Assessment of HAVS in Canada

The Occupational Health Clinic at St. Michael's Hospital in Toronto is the only site dedicated to detailed clinical assessment of workers with HAVS in the country. Elsewhere there is a much smaller volume of clinical assessments being done. There is considerable variation in assessment methods in various parts of the country. In general the assessments emphasize the measurement of cold-induced vasospasm (cold provocation digital plethysmography) or recovery of finger temperature after cold-induced vasospasm (thermometry or thermography).

(d) HAVS Classification

The Workshop reviewed the Stockholm scales which are based on Raynaud's phenomenon for the vascular scale and digital polyneuropathy for the sensorineural scale. It was concluded that these scales do not reflect the broad spectrum of outcomes that are seen in workers using vibrating tools. Therefore it was agreed that a more comprehensive classification system was needed. The classification developed by the Workshop is summarized in Table 2.

The classification of vascular outcomes should include Raynaud's phenomenon and thrombi in the hands. Raynaud's phenomenon is the most prevalent vascular outcome in workers using vibrating tools and the outcome most clearly related to vibration exposure.

There was considerable discussion about the neurologic component of HAVS. Since 1997 almost 1000 patients have been assessed for the neurologic component of HAVS at the Electromyography Laboratory at St. Michael's Hospital. All of these workers have had detailed nerve conduction studies with conventional electrode placement (i.e. non-fractionated nerve conduction measurement). The results of these nerve conduction studies indicated that 47% of the workers assessed for HAVS had no measurable abnormalities in peripheral nerve function in the upper extremities. Among those with abnormalities, the most common lesion was median neuropathy at the wrist. This was seen in 36% of the workers. About half of these workers with median neuropathy at the wrist had symptoms consistent with carpal tunnel syndrome. In this group about 75% were rated as mild carpal tunnel syndrome. The second most prevalent abnormality in nerve conduction testing was ulnar neuropathy which was present in about 6% of the patients. In this group approximately 90% were rated as having mild ulnar neuropathy. Only 2.5% of the workers assessed had diffuse neuropathy involving the hands. Therefore although the primary neurological lesion associated with the sensorineural component of HAVS is thought to be digital sensory neuropathy, this is found in nerve conduction testing with conventional electrode placement in only a small number of patients being assessed for HAVS. The most prevalent neurologic abnormality is carpal tunnel syndrome followed by ulnar neuropathy. Nerve conduction testing with conventional electrode placement does not appear to be a sensitive test for the measurement of the neurological damage associated with vibration. Other measurement modalities such as fractionated or segmental nerve conduction with electrodes being placed in the distal parts of the digits and quantitative neurological tests (such as current perception threshold or vibration perception threshold) may have more promise for the specific measurement of the neurological damage associated with HAVS.

The measurement of nerve conduction in manual workers is difficult because of a variety of factors. Age, height, sex and temperature may affect the measurement of nerve conduction and must be taken into account. Temperature is particularly problematic given the fact that in HAVS the fingers may be cold. As well recent studies suggest that hand size (finger circumference) has a very significant effect on the measurement of sensory amplitudes and therefore this needs to be taken into account in the evaluation of nerve conduction studies in manual workers.

The neurologist at the workshop indicated that, if vibration exposure causes damage to digital nerve fibers, this should be manifested as axon loss because that is how traumatic lesions affect the nerves in general. As such the axon loss would be manifested in nerve conduction studies by reduced amplitudes rather than by a slowing of conduction velocity. Therefore a key metric in the evaluation of the electrodiagnostic testing of these workers for digital sensory neuropathy is a reduction in sensory amplitude.

As indicated in Table 2, the neurologic outcomes associated with the use of vibrating tools should include, in addition to digital sensory neuropathy, proximal abnormalities, in particular median neuropathy at the wrist and ulnar neuropathy. Current evidence suggests that these proximal neuropathies are more related to ergonomic factors such as repetitive forceful flexion and extension of the wrists, but vibration may also play a role, especially in the development of median neuropathy at the wrist.

The musculoskeletal component includes a variety of possible outcomes including decreased grip strength, Dupuytren's contracture, bone cysts, osteoporosis of the hand / wrist bones, osteoarthritis of the wrist, elbow, shoulder and nonspecific upper extremity muscle / joint pain. In the evaluation of every musculoskeletal outcome the effect of vibration may be confounded by ergonomic factors. This is also the case for the proximal neurologic abnormalities and for the vascular outcome of thrombi in the hands where work practices (forceful striking with the hand) may confound any effect related to vibration exposure.

Our proposed classification would place HAVS into an expanded clinical sphere so that the full spectrum of health problems of workers using vibrating tools might be considered. The classification is based on health problems due to the use of vibrating tools and associated work practices rather than to vibration per se. It is hoped that this will promote increased knowledge and prevention. It is useful to consider whether each outcome is more likely to be related to vibration, ergonomic factors and/or specific work practices as this knowledge may affect the focus of preventive efforts. The evaluation of specific factors in causation will be an ongoing process as new research findings become available.

Table 2. The Canadian Workshop Classification of the Health Effects Associated with the Use of Vibrating Tools

<u>Vascular</u>

Raynaud's phenomenon **

Thrombi in hands
- Digital, ulnar, radial arteries

<u>Neurological Component</u>

Digital sensory neuropathy ** (involving distal nerve fibres and/or sensory receptors)

Proximal abnormalities
- Median neuropathy (wrist)
- Ulnar neuropathy

Musculoskeletal Component

Decreased grip strength
Dupuytren's contracture
Bone cysts
Osteoporosis of hand / wrist bones
Osteoarthritis – wrist, elbow, AC joint
Upper extremity muscle / joint pain

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

Notes:

1. This classification refers to the health effects associated with vibrating tools and not just vibration per se.
2. Raynaud's phenomenon and digital sensory neuropathy are the outcomes most clearly related specifically to hand-arm vibration exposure
3. The other outcomes may be related to ergonomic factors,work practices, and/or hand-arm vibration

(e) Diagnostic Testing

There is currently no generally accepted test for the diagnosis of Raynaud's phenomenon due to HAV exposure. The tests most commonly used now are plethysmography and thermometry. These tests should be evaluated in the particular clinical facility/context in which they are used to determine how the test conditions could be optimized (i.e. water temperature, duration of immersion, time of testing and cut points for a positive test) to maximize the utility of the tests. For example, the thermometry and plethysmography cut points for an abnormal test might be chosen to maximize the sensitivity of the test for screening purposes and the specificity of the test for diagnostic purposes. In terms of development of future tests for the diagnosis of cold-induced vasospasm, it was felt that the laser Doppler test and IR thermography appear to have the most promise. Optical microscopy should be used for the measurement of digital microangiopathy associated with Raynaud's phenomenon. For the detection of thrombi in the hands the gold standard test is currently angiography. The MR angiogram has considerable promise and may be used more frequently in the future in place of conventional angiography.

For the neurologic abnormalities nerve conduction testing is recommended in patients being assessed for HAVS. However conventional electrode placement does not allow measurement of neurological abnormalities in the distal fingers and therefore needs to be supplemented by additional tests, in particular quantitative sensory testing such as measurement of current perception threshold (CPT) or a combination of vibration perception threshold (VPT) and temperature perception threshold (TPT).

The diagnosis of musculoskeletal abnormalities related to the use of vibrating tools depends principally on history and physical examination with the utilization of additional tests such as x-ray, CT scan , MRI scan or bone density measurement, depending on the particular abnormality detected on the examination. Pinch strength and grip strength may be measured as overall functional outcomes and a test of manipulative dexterity may be done such as the Purdue pegboard.

(f) Research

It was agreed that the research agenda for HAVS, while trying to advance understanding of the clinical spectrum of HAVS and its measurement, should also focus on applied research of educational programs and KTE. To help to achieve these goals the participants agreed to continue to work together to advance understanding and recognition of this problem with a focus on prevention.

4. Conclusions

The presentations and discussion at this workshop highlighted the fact that hand-arm vibration has not received sufficient attention in Canada. There is a need for improved recognition and reporting of HAVS and improved regulation and preventive efforts for HAV in Canada. A classification of the health effects associated with the use of vibrating tools was discussed which might lead to improved recognition and prevention. A need was identified for improved knowledge transfer and exchange (KTE) regarding HAV/HAVS and the inclusion of KTE topics in future research related to HAV/HAVS with a focus on prevention.