MEASURING PHYSIOLOGICAL AND BIOCHEMICAL CHANGES IN WORK-RELATED VIBRATION

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Introduction

Until now there has been controversy about which tests should be performed to diagnose early Hand-Arm Vibration Syndrome (HAVS). Initial screening questions, especially about tingling and numbness, routinely given to patients prior to examinations proved to be a very important tool in the diagnostic process¹⁴. However, standardized tests that are simple, quick, valid and reliable are needed to support a diagnosis of HAVS. **Purpose:** To find the most valid and reliable tests to diagnose HAVS.

Material and Methods

Five major tests were performed on Group I and Group II. Group I: Control group of 12 volunteers including students, nurses, secretaries and physicians with no history of using vibrating tools (age 20 to 50y, mean age 38.5y; 5 male, 5 female.) Group II: 12 workers (age 17 to 65y, mean age 39y; 9 male, 3 female) were sent by a local trade union with a history of using vibrating power tools on their jobs for varying amounts of time (mean 12.2y, from 0.5 to 35y.) Pre-enrollment survey showed that each had more than 4 complaints commonly associated with use of vibrating tools (including numbness, tingling, weakness, pain, finger color or nail changes, temperature change, and difficulty moving.)

1. Sensory nerve conductive tests: Amplitude and nerve conductive velocity (NCV) were evaluated. 2. Cold Stress-Temperature recovery time tests were done on the index finger of the dominant hand following these steps: Confirm water bath is within 4-5º C. Place the finger temperature probe on pad of the index finger of the dominant hand. Record temperature every 15 seconds. Place subject’s hand in the cold-water bath for exactly five minutes. Record temperature every 15 seconds for ten minutes. 3. Blood test: Venous blood was taken by a 21-gauge needle with the yellow collection tube adapter. S-ICAM, Sera Thrombomodulin, Norepinephrine levels were evaluated by Henderson Research Centre, Canada. 4. Finger Sensory Evaluation: Semmes-Weinstein monofilament test and 2-point discrimination tests were performed on bilateral fingers. 5. Digital blood pressure test: blood pressure was measured in bilateral index fingers.

Results

1. Median nerve sensory conductive amplitude from palm to wrist:
   GI: mean 96 ± 31µm; GII: mean 43± 30µm; for dominant hands.
   GI vs GII: P<0.001
Motor nerve conductive velocity (NCV) from elbow to wrist:
GI: mean 60.8± 8.5m/s; GII: mean 48.3± 5.9m/s; GI vs GII:  P<0.001

2. Cold-Stress Test: Temperature Recovery Rate (TRR) = T before test / T after 10 minutes.
GI: mean: 85.36% ± 14.22 GII: More three years of using vibrating tools was a critical point, with vibration for 3 years, the TRR was 70% and as time of use increased, the correlation to TRR also increased. Two subjects’ TRR was 52% with 15 and 35 years of using vibrating tools.

3. Sera Chemical Test: A. sICAM: Standard Reference Range is 132.5-344.2ng/mL. GII: The value of 3 workers > 344.2ng/mL (385.2, 346.4 and 381.4), Positive rate was 25.0%; B. Norepinephrine: Standard Reference Range is 0.8-3.4; 4 workers’ value was <0.8 nmol/L (0.5, 0.7, 0.3, 0.6). Positive rate was 33.3%.

4. Hand Sensory Evaluation:
   A. Semmes-Weinstein monofilament test: Standard criterion: Normal: 1.65-2.83; Diminished light touch: 3.22-3.61; Diminished protective sensation: 3.84-4.31; Loss of protective sensation: 4.59-6.65. Results: 3 workers (3.5years) were normal; 9 workers (>5 years) were diminished. Positive rate was 66.98%.
   B. Two-point discrimination test: Normal is < 6mm. GI: 119/120 tested fingers were less than 6 mm; GII: 20/120 were < 6mm. Positive rate was 16.7 %.

5. Digital blood pressure test: Normal cut-off point: < 70 mmHg was abnormal. Results: GI: none was < 70; GII: 8/23 fingers (n=23, index fingers in both hands, 1 n/a); positive rate was 35%.

Conclusions

1. Semmes-Weinstein monofilament test is a sensitive and simple test to assess HAVS. 2. Cold stress test gave a lower positive rate but did indicate later damage; however, it causes patient discomfort. 3. Sensory nerve conductive and NCV were useful but need a control group value. 4. The S-ICAM increased in 25%, and NE decreased in 33% of vibrated workers. 5. Digital BP test and 2-point discrimination test both have cut-off point value; they could be used to differentiate HAVS from simple carpal tunnel syndrome.

References