Significance of Finger Coldness in Hand-Arm Vibration Syndrome

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Abstract

Objectives: To evaluate the relationship between subjective symptoms of coldness in fingers and peripheral circulation in patients with hand-arm vibration syndrome (HAVS).

Methods: Thirty-five male patients confirmed to have HAVS as an occupational disease took part in this study. Their mean age was 62 years (SD 5) and all were chain-saw operators exposed to vibration for an average of 25 years. Their annual health examination included the history of their daily habits (smoking, drinking, and therapeutic exercise), report of subjective symptoms such as coldness, numbness and tingling in the fingers, and a physical examination; laboratory tests consisted of skin temperature measurement, and pain and vibration perception under conditions of cold provocation. A frequently used method of cold provocation, immersion of the left hand up to the wrist in water of 10°C for 10 min, was used.

Results: Finger coldness was classified into 3 groups according to its severity: mild group (n=8), moderate group (n=17) and severe group (n=10). There was no significant difference in age or occupational background between the groups. A significant association was found between finger coldness and prevalence of Raynaud’s phenomenon (p<0.001, χ²-test). The mean skin temperature was significantly lower with the severity of finger coldness (ANOVA, p<0.05). In the cold provocation test, there was no significant difference between skin temperature and coldness at 5 min and 10 min after immersion, though a difference was observed immediately after immersion. No significant difference was observed in the relationship between finger coldness and vibrotactile threshold before, during or after the cold provocation test.

Conclusions: The severity of coldness in the fingers is significantly related to skin temperature. The severity of finger coldness reflects the extent of peripheral circulatory vasoconstriction. Coldness in the fingers may be a good warning of potential problems in peripheral circulatory function.

Key words: hand-arm vibration syndrome, finger coldness, significance

Introduction

In Japan, occupational health problems relating to hand-arm vibration syndrome (HAVS) were investigated in the late 1960s by studying national forestry workers in and subsequently, those in mining and stone quarry industries. Based on previous research, a comprehensive system intended to prevent HAVS in Japan was introduced in the 1970s. The greatest peak of new patients was observed in all sectors of industry in the late 1970s (1). Following the introduction of preventive strategies, such as improvements in vibrating tools and insis-tence on special annual health examinations, the number of new patients has decreased dramatically (1).

A special annual health examination for hand-arm vibration syndrome (HAVS) was introduced and regulated by the Industrial Safety and Health Law in Japan, starting from 1975 (2). About 40,000 workers underwent this health examination in 2004 and the rate of prevalence of abnormal findings was 6.0%. In Japan, the number of workers who use vibratory tools in their occupations was estimated to be at least 2 million, and the number of workers requiring annual health examination was 200,000. It seems that most workers who use vibratory tools occupationally had no chance to undergo this special annual health examination. In fact the number of new patients has increased again in recent years, particularly in the construction and manufacturing industries. About 600 people per year, mainly ex-workers, were designated as new cases of HAVS. It is therefore very important to detect the early stage of HAVS to stop its progression.
Finger coldness has so far not been well evaluated, because of various difficulties. The Stockholm criterion, used internationally to evaluate the stages of clinical features in affected workers exposed to hand-transmitted vibration, involves Raynaud’s phenomenon for vascular findings but not finger coldness (3). Some researchers have reported that symptoms of finger coldness preceded the initial occurrence of Raynaud’s phenomenon in workers who had used vibratory tools for long periods (4–6). Finger coldness could be a reflex condition of spastic vasoconstriction in peripheral circulation. Yamada et al. (5) proposed a typical clinical course for the stages of HA VS (Fig. 1). Although finger coldness is based on subjective complaints and is not evaluated quantitatively, this index could be helpful in evaluating peripheral circulatory disorder in the early stage of HA VS. The present study is aimed at evaluating the relationship between subjective symptoms of coldness in the fingers and peripheral circulation in patients with HA VS. We also consider the relationship between coldness in the fingers and peripheral circulation in healthy women.

**Methods**

**Study 1**

Thirty-five male patients confirmed to have HAVS as an occupational disease took part in this study. Their mean age was 62 years (SD 5) and all were chain-saw operators exposed to vibration for an average of 25 years. Their annual health examination included a history of their daily habits (smoking, drinking, and therapeutic exercise), report of subjective symptoms such as coldness, numbness, and tingling in the fingers, and laboratory tests including skin temperature measurement, and pain and vibration perception under conditions of cold provocation. The degree of finger coldness was defined by its severity and area of the finger, using a special health examination questionnaire for hand-arm vibration syndrome. Finger coldness was divided into 3 grades according to its severity: mild, moderate, and severe. A frequently used method of cold provocation, immersion of the left hand up to the wrist in water at 10°C for 10 min, was used. Finger skin temperature was continuously measured at the back of the middle phalanx of the third finger of the left hand, using a thermometer (HD-111, Takara, Japan) before, during and after cold-water immersion. Finger vibrotactile thresholds, as measures of peripheral neurological functions, were examined at the palmar distal phalanx before immersion, immediately after immersion, and 5 min and 10 min after immersion. The vibrotactile threshold was measured at 125 Hz with a vibration sensimeter (AU-02, RION, Japan). The room temperature during laboratory testing was maintained at 20°C to 22°C by an air-conditioning system.

**Study 2**

We examined the relationship between sensations of cold and peripheral circulation in healthy young women. Twenty healthy females (nurse students) took part in this preliminary study. Their mean age was 20 years, and there was no history of Raynaud’s phenomenon. The questionnaire concerned: 1) the history of daily habits: smoking, drinking, and physical exercise, and 2) subjective symptoms of coldness: finger coldness, intolerance to cold, intolerance to air conditioning. Skin temperature was measured under conditions of cold provocation (10°C-water immersion for 10 min). The room temperature during laboratory testing was maintained at 20°C to 22°C strictly by an artificial climate control system. Prior to the study, the contents of the experiment were carefully explained to all the subjects, and informed written consent was obtained from them. However, this study was not approved by the Ethical Committee for the Clinical Research of Kurume University because this study had done in 2001 before this committee was established. In statistical analysis of the data, a \( \chi^2 \)-test was used to compare the prevalence of Raynaud’s phenomenon and finger coldness. An ANOVA (analysis of variance) method was used for comparison of finger coldness and skin temperature. Differences were taken to be statistically significant when \( p < 0.05 \). These statistical analyses were conducted using a JMP computer program (SAS Institute, USA; version 5).