The validity of Raynaud’s phenomenon symptoms in HAVS cases

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Introduction

Hand–arm vibration syndrome (HAVS) is a recognized disorder causally related to occupational exposure to vibrating hand tools. This syndrome may include digital vasculopathy, upper extremity peripheral neuropathy and musculoskeletal problems. One of the prominent components of HAVS is secondary Raynaud’s phenomenon previously referred to as vibration white finger (VWF) [1,2]. This is the result of digital vasospasm occluding blood flow to the digits usually triggered by exposure to cold. The lack of blood flow produces the characteristic transient pallor or blanching of the fingers commonly associated with numbness and paraesthesia of the involved fingers with the thumbs being least affected [3–7].

By consensus, subjective symptom reporting of Raynaud’s phenomenon along with a consistent history of long-term exposure to vibrating hand tools is sufficient to make the diagnosis of HAVS [1,6,8,9]. In fact, a history of Raynaud’s phenomenon provided by the worker has been described as the ‘gold standard’ [7] and is the basis of the most commonly used severity grading scale for vibration-related vascular disorders, the Stockholm Workshop Classification Scale [4]. In addition, the development of objective tests of digital vascular response abnormalities related to HAVS has typically relied on the history of Raynaud’s phenomenon provided by vibration-exposed workers as the reference standard on which the validity of the test is determined [8,10–14].

Subjective reporting, however, may not always be an accurate or reliable method to diagnose occupational disease especially when compensation is involved and symptom over reporting may be a confounding factor [2,15–18]. This study attempts to evaluate the validity of subjective symptoms of Raynaud’s phenomenon reported by workers seeking compensation for HAVS, using a simple, inexpensive photographic method to visually document reported colour changes of the fingers and hands.

Background
Raynaud’s phenomenon, a common manifestation of the hand–arm vibration syndrome (HAVS), is typically diagnosed by a subjective history provided by employees.

Aim
This study evaluates the validity of the subjective history of Raynaud’s phenomenon provided by individuals applying for compensation for HAVS.

Methods
Thirty-six workers with a history of occupational hand–arm vibration exposure who were labelled as having Raynaud’s phenomenon were asked to photographically document their finger symptoms before undergoing a detailed clinical assessment. Each individual was provided with a disposable camera and instructions. Returned photographs were reviewed for signs of Raynaud’s phenomenon. The reliability of photographic interpretation was tested with three physicians and a non-physician.

Results
Inter and intra-rater reliability was very good, Kappa coefficient $>0.80$. Six individuals (17%) did not return cameras. Thirty individuals provided photographs and underwent a clinical evaluation. The photographs of 13 individuals (43%) did not show Raynaud’s phenomenon and for four of these the diagnosis was not supported by careful symptom history. Seventeen individuals (57%) had photographic evidence of Raynaud’s phenomenon.

Conclusions
A presenting history of Raynaud’s phenomenon in workers seeking compensation for HAVS may not be accurate since approximately half the cases are unable to provide objective photographic evidence of Raynaud’s phenomenon.

Key words
Blanching; hand–arm vibration syndrome; photography; Raynaud’s phenomenon; vibration white finger.

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Methods

In the province of British Columbia, Canadian workers applying for compensation for HAVS are required to have an independent occupational medical evaluation. The referral for this evaluation includes information provided by the primary care physician as well as a history of symptoms obtained by a case manager from the worker. All workers referred to the author for an independent medical evaluation between June 2004 and October 2006 with a referral history of Raynaud’s phenomenon were included in this study. All these cases had been labelled as having Raynaud’s phenomenon or white finger disease and/or had descriptors such as blanching, whiteness or pale fingers.

All workers were sent a disposable camera to help document their finger blanching symptoms. Along with each camera, the workers were provided with illustrated instructions on how to obtain the required photos. The workers were asked to provide at least two sets of photos, one when they had symptoms of finger blanching and the other when their hands were normal. For each set, the workers were asked to provide four views of both hands including palmar and dorsal views with the hands at waist level and with hand held near to their face. The workers were encouraged to take additional photographs of the hands beyond the minimally required two sets to demonstrate any abnormalities. Additional cameras were dispensed if for some reason the first camera was lost, damaged or defective.

The workers were not given a deadline and they could take as much time as necessary to provide the photographs. However, for the purpose of the study, an arbitrary time limit for the camera return was set to the end of August 2007.

Once the photographic record was completed, the workers were asked to return the cameras; the film was developed and stored digitally on compact discs for review. Subsequently, the workers were evaluated clinically and the photographs were reviewed with them. The clinical evaluation included a detailed history of symptoms and work exposure. The Raynaud’s phenomenon symptoms were obtained by neutral, open-ended enquiry avoiding leading questions regarding digit or hand blanching [6,19]. The patients were left to describe their symptoms in their own words. Typical questions would be: How do your hands bother you? How are your hands affected? Do you have problems with your hands? Describe these problems. The symptom enquiry was repeated and the workers were given ample opportunity to describe any and all abnormalities involving their hands and upper extremities.

To evaluate the reliability of the interpretation of the photographs, two sets of photograph for each worker (or what was minimally available) were evaluated by three physicians and a non-physician. Each rater was provided with the same photographs for each worker demonstrating the hands with symptoms and without symptoms as indicated by the workers and asked if blanching was present or not. These were anonymous photographs showing only the patients’ hands. The reliability of interpretation was determined by the Kappa coefficient [20]. Intra-rater reliability was assessed using a set of six duplicate photographs whose orientation was changed. For the purposes of this study, Raynaud’s phenomenon was defined as well-demarcated pallor or blanching of the fingers with the blanching always beginning at the distal tip of one or more digits and in more advanced cases the pallor extends more proximally to involve the length of the fingers, sometimes extending into the palm. The raters simply indicated if they believed Raynaud’s phenomenon was present or not; they did not rate the severity of blanching.

Results

A total of 36 patients received a camera over the 29-month study period. These included 35 males and 1 female. Three patients required a second camera. Thirty patients (83%) returned cameras and six (17%) did not return cameras by the cut-off date for the study (31 August 2007) despite repeated contact and requests to return the cameras (Table 1).

The time to return the 30 cameras ranged from 7 to 226 days (1–32 weeks). Half the cameras were returned within 47 days or <7 weeks while 90% of the cameras were returned within 182 days or by ~6 months. The mean number of days to return the cameras for the 30 patients was 68 days (SD 62 days). For the six individuals who did not return the cameras by the end of the follow-up date, the time interval from when the cameras were sent to the patients to the end of the follow-up period ranged from 402 to 997 days (13 months to over 2½ years) with a median of 499 days and a mean of 640 days (SD 225 days).

The reliability of the photograph interpretation among the four raters was very good, with the Kappa values at 0.84 or better. The reliability of each rater was also good with intra-rater Kappa = 1 for all four raters. The interpretation of the four raters was combined to give a consensus interpretation of the photographs. The photographs were accepted as showing Raynaud’s phenomenon or not if the majority of raters rated them as such. If the rating of the photos was tied, two raters indicated the presence of Raynaud’s phenomenon and the other two not, then the photographs were considered as showing Raynaud’s phenomenon (Table 1).

The photographs of 13 of 30 (43%) patients who returned photographs did not demonstrate Raynaud’s phenomenon, while 17 of 30 (57%) did. Four of the 30 (13%) individuals who returned cameras did not actually describe typical finger blanching symptoms of
Raynaud’s phenomenon during the clinical evaluation and this was congruent with the photograph which did not show blanching either.

**Discussion**

Raynaud’s phenomenon is one of the most common manifestations of HAVS and it is typically diagnosed by history. Diagnosing Raynaud’s phenomenon by direct observation of the vasospastic phenomenon is the most accurate and preferred way to confirm HAVS [9,12,21]. However, this manifestation is sporadic, unpredictable, rarely witnessed by a physician and not reliably induced [1,14,22]. This study attempted to evaluate the accuracy of the presenting history of Raynaud’s phenomenon among workers seeking compensation for HAVS by the visual confirmation of digital vasospasm using photographic documentation.

The simple photographic method used in this study was a reliable way to document ephemeral skin colour changes related to Raynaud’s phenomenon with a Kappa coefficient >0.80 among four independent raters. This indicates that individuals interpreting the photographs will tend to agree most of the time on the presence or lack of blanching. Olsen in an older study [12] used cold water provocation testing in conjunction with photographs post-cold water provocation to document Raynaud’s phenomenon and found the interpretation of the photographs to be reliable with a Kappa score of 0.93. This
same study also concluded that photographs of cooled hands post-provocation showing Raynaud’s phenomenon was as valid as direct visualization post-provocation and when finger systolic pressure post-provocation was zero [12]. A reduction of finger systolic pressure to zero on cold-provocation testing represented an objective sign of Raynaud’s phenomenon with complete closure of the digital arteries [12,14].

The results of this study indicate that a presenting history of Raynaud’s phenomenon prior to clinical assessment may not always be valid by itself to make the diagnosis of Raynaud’s phenomenon among individuals seeking compensation for HAVS. This includes information provided by case managers and primary care physicians. Among individuals who had been described as having Raynaud’s phenomenon or VWF, a careful medical history using neutral questions revealed that 4 of 36 individuals actually did not complain of symptoms consistent with the diagnosis of Raynaud’s phenomenon. These individuals also did not have photographic evidence of Raynaud’s phenomenon. This indicates that perfunctorily collected information may falsely label some individuals as having Raynaud’s phenomenon or HAVS. In this study, this misdiagnosis involved ~10% of the referred cases.

The majority of subjects in this study, >80% (30/36), were able to provide photographs as requested but a substantial portion; 17% (6/36) did not return cameras at all despite frequent inquiries and no time limitations. These individuals had ample opportunity to provide photographs and replacement cameras were readily offered. In fact, they had the cameras on average nearly 10 times longer than those who did provide photographs, 640 days compared to 68 days, respectively. There was no apparent explanation for this non-compliance. Among the subjects who returned the camera and provided a history on clinical assessment of Raynaud’s phenomenon, approximately one-third (9/26) did not demonstrate blanching on the photographs they provided.

Therefore, out of a total of 36 subjects labelled as having Raynaud’s phenomenon applying for compensation for HAVS during the study period, >10% (4/36) did not actually complain of Raynaud’s phenomenon symptoms during careful clinical assessment and 40% (15/36) could not provide objective photographic evidence of Raynaud’s phenomenon.

A number of factors could explain this high proportion. Claim managers dealing with these individuals could have inaccurately presumed that all individuals who work with vibrating power tools and who complain of upper extremity symptoms have HAVS. Similarly, treating physicians may fail to take a careful history using neutral enquiry (rather than leading questions) and may provide a presumptive diagnosis of Raynaud’s phenomenon to patients with vague hand symptoms and a history of working with power tools. In some cases, symptoms over reporting and malingering may be involved to maximize compensation benefits. Symptom over reporting and malingering in medico-legal cases involving compensation have been reported in one-third or more cases [17,18].

Based on the observations made in this study, subjective symptoms reporting of Raynaud’s phenomenon obtained during careful clinical evaluation may not be accurate to diagnose HAVS. Using the photographic method as the reference standard, one can obtain estimates of the validity of clinical history of Raynaud’s phenomenon during a HAVS assessment (Table 2). The estimated sensitivity of symptoms of Raynaud’s phenomenon is 100% but the specificity is only 31%. The positive predictive value of a careful clinical history of finger blanching based on neutral questions is 65% and the negative predictive value is 100%. Therefore, individuals who do not report symptoms of blanching during medical history utilizing neutral open-ended questions are unlikely to have HAVS while those who do report blanching more than one-third may not have the condition.

Potential limitations of this study include the small number of cases and that the clinical evaluation was performed by a single examiner who was unblinded to the photograph results which may be a potential bias. Having a single examiner, however, may be advantageous for maintaining the consistency in history taking. Also, the format of the interview purposely provided ample opportunity for workers to describe their hand symptoms with repeated open-ended questioning.

Strengths of the study include the high reliability of photographic interpretation for the presence or absence of Raynaud’s phenomenon. The rating of the photographs used in the analysis was an amalgamation of the interpretation of all four raters avoiding the potential bias of a single rater. The method of acquiring the photographic evidence was kept simple and there were no time pressures imposed on the participants. The majority of patients were able to return cameras and provide photographs of their hands.

Table 2. Validity of symptoms of Raynaud’s phenomenon reported by the patients during the clinical evaluation relative to the photographic evidence of Raynaud’s phenomenon provided by the patients

<table>
<thead>
<tr>
<th>Reported symptoms of Raynaud’s phenomenon during clinical assessment</th>
<th>Yes</th>
<th>No</th>
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<tbody>
<tr>
<td>Raynaud’s phenomenon based on photographic evidence</td>
<td>Yes</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>26</td>
<td>4</td>
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Sensitivity = 17/17 = 100%; specificity = 4/13 = 31%; positive predictive value = 17/26 = 65%; negative predictive value = 4/4 = 100%.
While the small sample size in this study limit accurate quantification, the available data indicate that the presenting history of Raynaud’s phenomenon among workers seeking compensation for HAVS may not be accurate in about half the cases and even a careful clinical history obtained in a specialty clinic may be inaccurate one-third of the time. Therefore, it is imperative that the diagnosis of Raynaud’s phenomenon secondary to HAVS be confirmed by objective methods particularly for medico-legal purposes. This may include properly validated laboratory tests, visualization of blanching directly by a physician [6,9,13] or a photographic method similar to the one described in this study.

Key points

- Subjective symptom reporting of Raynaud’s phenomenon by individuals seeking compensation may not always be accurate.
- Open-ended questions should be used during the clinical evaluation of HAVS cases.
- Objective testing should be used to confirm symptom reporting of Raynaud’s phenomenon in compensation cases.

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Conflicts of interest

None declared.

References