

Health surveillance - Guidance for Occupational Health Professionals

This document advises health professionals on the clinical effects of HAV and the implementation of a health surveillance programme for workers exposed to HAV.

Clinical effects

Workers whose hands are regularly exposed to vibration may suffer from symptoms due to pathological effects on the peripheral vascular system, peripheral nervous system, muscles and other tissues of the hand and arm. The symptoms are collectively known as hand-arm vibration syndrome (HAVS).

Neurological component

Neurological symptoms of HAVS include numbness and tingling in the fingers, and a reduced sense of touch and temperature. This nerve damage can be disabling, making it difficult to feel, and to work with, small objects.

Vascular component

Episodic finger blanching is the characteristic vascular sign. This is sometimes known as 'vibration white finger', 'dead finger' or 'dead hand'. The main trigger for the symptoms is exposure to the cold, for example being outdoors early on a winter's morning. The symptoms can also be triggered by localised or general body cooling in otherwise warm environments. Although vibration causes the condition, it does not precipitate the symptoms.

After initial blanching indicating vasospasm, the circulation is restored, either spontaneously (after a variable period of time that can be from several minutes to an hour or more) or after rewarming the fingers. Tissue ischaemia occurs during the period of spasm. This leads to an exaggerated return of blood flow and painful red throbbing fingers (reactive hyperaemia). During attacks the sufferer may complain of numbness, pain and cold as well as reduced manual dexterity. Effects are seen initially in the tips of the affected fingers, with changes then spreading up the finger with continuing exposure. The thumb may also be affected. As the condition progresses, the frequency of attack will increase. Rarely, in very severe cases, blood circulation may be permanently impaired.

Muscular and soft tissue component

Workers may complain of joint pain and stiffness in the hand and arm. Grip strength can be reduced due to nerve and muscle damage.

An individual worker suffering from HAVS may not experience the complete range of symptoms, for example symptoms related to the neurological component can be present in the absence of vascular problems and vice versa. Neurological symptoms generally appear earlier than finger blanching.

Carpal tunnel syndrome, a disorder of the hand and arm giving rise to tingling, numbness, weakness, pain and night waking, can be caused by exposure to vibration.

Employees suffering from HAVS can experience difficulty in carrying out tasks in the workplace involving fine work or manipulative work and have a reduced ability to work in cold conditions. The disease may also have an impact on social and family life. Periodic attacks of “white finger” will take place not only at work, but also during activities such as car washing or watching outdoor sports. Everyday tasks, for example fastening small buttons on clothes, may become difficult.

Prognosis

The symptoms of HAVS are usually progressive with continuing exposure to HAV. There will be individual variation in the timing and rate of deterioration. The degree to which symptoms regress on removal from exposure to vibration is not known with any certainty and the condition may be irreversible. There is limited evidence to indicate that neurological symptoms do not improve. Vascular symptoms may show improvement after reducing or ceasing vibration exposure in patients below about 45 years of age and when the disease has not yet reached the advanced stage associated with disability. Any improvement is, however, slow, taking several years. Smoking may undermine recovery in these individuals. The vascular symptoms do not normally get worse after discontinuing exposure to HAV and in people where deterioration does arise this may be associated with other conditions (for example, collagen vascular disorders). The condition can, however, appear for the first time up to one year after the last exposure.

When is health surveillance required?

Regulation 7 of the Control of Vibration at Work Regulations 2005 requires employers to provide suitable health surveillance where the risk assessment indicates a risk to workers' health. In any case, workers likely to be exposed in excess of the daily exposure action value of $2.5 \text{ m/s}^2 A(8)$ should be under suitable health surveillance.

Health surveillance should be instituted for:

- employees who are likely to be regularly exposed above the exposure action value;
- employees likely to be occasionally exposed above the exposure action value where the risk assessment identifies that the frequency and severity of exposure may pose a risk to health; and
- employees who have a diagnosis of HAVS (even when exposed below the exposure action value).

Competency and training

It is essential that health professionals involved in health surveillance for HAVS can demonstrate that they have the necessary expertise. Specialist training is required to carry out adequate clinical assessments and avoid misdiagnosing symptoms of HAVS.

The Faculty of Occupational Medicine has adopted a framework of competencies and a syllabus of approved training for health professionals involved in health surveillance for HAVS. These Faculty documents can be found in Hand-arm vibration The Control of Vibration at Work Regulations 2005 (L140). The syllabus is designed to enable training providers to prepare health professionals for an examination leading to a qualification approved by the Faculty. Health professionals should have gained this qualification or have achieved an equivalent level of competence. They should also have more general training in occupational health or occupational medicine, normally demonstrated by having a diploma certificate or degree in occupational health or diploma in occupational medicine or by being an associate or member of the Faculty of Occupational Medicine.

Following the introduction of the Vibration Regulations in 2005, there may be a short-term need for health surveillance for HAVS to be carried out by professionals who have not yet had the necessary specialist training. They should, however, possess general occupational health or medicine qualifications and be familiar with the contents of this guidance. It is recommended that they complete the specialist training at an early opportunity. If reasonably practicable, such individuals should make arrangements to be able to consult a person with specialist knowledge of HAVS for advice as necessary.

The Faculty syllabus includes relevant information on conducting a health surveillance programme for HAVS and on wider issues such as the legal background, understanding of routes of vibration exposure, pathophysiology and the appropriate management of the condition. It is anticipated that a range of academic and private institutions will provide training courses based on the Faculty's syllabus. All health professionals involved in health surveillance for HAVS are expected to maintain up to date knowledge of the subject.

The health surveillance programme

It is important to give appropriate information to employees and encourage their full co-operation. Occupational health professionals who are providing clinical assessment and overseeing the health surveillance programme can assist employers to explain the serious nature of the disease and the aims of health surveillance. There is a need to ensure that workers are aware that the results of their health surveillance, with respect to fitness for work, will be disclosed to their employer, but that no clinical information can be given to anyone else without their consent.

The aims of the health surveillance programme are primarily to safeguard the health of workers (including identifying and protecting individuals at increased risk), but also to check the long-term effectiveness of control measures. One of the specific aims is to prevent workers developing a degree of HAVS that is associated with disabling loss of hand function. Health surveillance for HAVS is appropriate where a risk assessment has shown the need and it should operate alongside a programme of vibration risk control measures.

When cases of the occupational diseases, HAVS and carpal tunnel syndrome in association with HAV, are diagnosed by a doctor, they should be reported by the employer in accordance with Regulation 5 and Schedule 3 of the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR), 1995.

When health surveillance is required, it should be carried out annually. Both initial (or baseline) assessment and routine health surveillance are needed for HAVS. Early assessment of newly-exposed workers is recommended, as susceptible individuals can develop symptoms in 6 months or less. Exposed workers should receive information on why and how to detect and report symptoms of HAVS.

Medical records

A record-keeping system for holding results of medical examinations and reports of symptoms will be needed as part of the health surveillance scheme. These are confidential medical records relating to individuals. As part of the health surveillance programme, workers should be informed of the confidential results of each assessment and of any implications of the findings, such as the likely effects of their continuing to work with vibration.

A tiered approach to health surveillance

To identify employees with symptoms that require further investigation, while avoiding unnecessary use of specialist resources, a tiered approach to health surveillance is recommended. Occupational health professionals experienced in the clinical assessment and diagnosis of HAVS are specialised and therefore they are a limited resource. To take this into account, most appointments with doctors or nurses are limited to cases where symptoms suggestive of HAVS have been reported.

Roles of health professionals

The qualified person is a specialised health professional, usually an occupational health nurse, competent to make enquiries about symptoms and to carry out clinical examinations for assessment of HAVS.

The doctor is a specialised health professional, usually an occupational physician, competent to carry out clinical examinations and diagnosis of HAVS. The *doctor* is responsible for formal diagnosis and fitness for work decisions.

For a description of the competency and training expected of these health professionals, see **Competency and training**.

Tier 1 Initial or baseline assessment

Health surveillance programmes need to include an initial assessment for any new or existing employee before they begin exposure to HAV. One reason for this is that a baseline should be available from which to judge the results of routine health surveillance. The baseline assessment forms Tier 1.

New employees, or those changing jobs, who will be exposed for the first time, should be given suitable information about the hazards of HAV (for example, the HSE pocket card *INDG296(rev1)* Hand-arm vibration: Advice for employees), preferably before they give information related to their medical status. This will help to alert the employee to the potential health consequences of failing to report symptoms of HAVS. Tier 1, also provides an opportunity to educate workers about measures under an employees control that will help to reduce the risks from transmission of vibration.

As a minimum requirement, initial pre-exposure assessment can be carried out using a self-administered questionnaire that includes questions about the person's medical history and is to be returned in confidence to the health professionals (see *pre-employment questionnaire*). Employees with no symptoms suggestive of HAVS, or relevant medical history, should be considered fit for work with exposure to HAV. The qualified person or doctor will see those with possible symptoms of HAVS for further assessment. The doctor will then decide whether the person is fit to work with HAV exposure.

It is recommended that individuals who suffer from certain relevant vascular or neurological disorders affecting the hand or arm eg, Raynaud's disease, carpal tunnel syndrome, are not exposed to vibration at work. Initial assessment by questionnaire and, if necessary, clinical assessment by the qualified person and the doctor will identify these individuals.

Tier 2 Annual (screening) questionnaire

This should be repeated annually to form the routine health surveillance for employees who are at risk but have not reported any symptoms suggestive of HAVS. A simple questionnaire is used to form an initial assessment of potential health effects (see *Annual questionnaire*).

The questionnaire can be used as a self-administered tool to gather information. Ideally, workers should be given reminders about the nature of the symptoms and the need to report them. It is useful to have a responsible person appointed as part of the health surveillance programme to help communicate to the employees how the simple screening questionnaire operates. Such a person should be carefully selected to have experience of the working environment and be able to gain the confidence and cooperation of employees. They need not be qualified but should have received training from an occupational health professional. They should understand the health surveillance procedures and the importance of confidentiality. They should be able to describe symptoms of HAVS but should not attempt to

diagnose disease. If an employee discloses that they have symptoms, the responsible person should not make judgements about the cause of the symptoms.

Completed questionnaires may be processed by the responsible person provided that this is acceptable to employees. However, it may be appropriate to have the questionnaires sent directly to the occupational health service provider so that the *responsible person* and employer do not see the answers given by individual workers. If the worker indicates “yes” to any of the questions on the form, this does not mean that HAVS has been identified. Instead, the worker should be referred to a specialised nurse (qualified person) or doctor as the “yes” triggers entry into a more detailed clinical assessment process, described here under Tiers 3 and 4. In the absence of reported symptoms, there is no need for referral for further assessment but the questionnaire should be repeated at 12-month intervals. This means that many workers will not need to attend an appointment with a health professional.

If symptoms appear for the first time or progress, workers should be encouraged to report any symptoms and not to wait until the next time that screening is carried out. Any reporting of symptoms triggers the need for further assessment (Tiers 3 - 4). HSE recommends that after three years of reporting no symptoms the worker should be referred for a consultation with the qualified person to provide an opportunity to more fully explore any possible symptoms that the individual may have experienced without appreciating their full significance.

Tier 3 Assessment by qualified person

This should normally follow Tier 2 if symptoms are reported. The assessment should be conducted by the qualified person. The doctor may be involved in carrying out some or all of the assessment in Tier 3, according to the local arrangements made by the providers of health surveillance.

34. An administered clinical questionnaire that asks about relevant symptoms and a limited clinical examination are recommended. It is helpful to have a standardised questionnaire on which to record information about the individual’s history of exposure to HAV at work, any significant leisure time exposure, current medication, symptomatology and the results of the clinical examination. Recommended content for this questionnaire can be obtained by referring to the Clinical questionnaire and detailed guidance on the procedures can be found in the section “**Clinical assessment for HAVS**”. The clinical examination by the qualified person is not a full medical examination but a targeted assessment. Examination is directed at vascular and neurological function in the arm and hand; a number of specific tests may be appropriate. A limited musculoskeletal examination is also recommended. An assessment of grip strength and manual dexterity should be made, ideally using a dynamometer for grip strength and the Purdue pegboard or other means for manual dexterity. If relevant symptoms are reported or clinical effects found, diagnosis, described below, will be required. A presumptive diagnosis may be recorded in Tier 3, as the role of the occupational health nurse or qualified person develops, but formal diagnosis is made by a doctor in Tier 4.

Tier 4 Formal Diagnosis

Formal diagnosis is made by the doctor. Formal diagnosis is required for certain actions including reporting by employers of cases under RIDDOR 1995 and fitness for work recommendations. Doctors can help considerably in the reporting process by using the precise description of the disease listed in the Regulations so that the employer will be able to identify immediately whether the case is reportable (see Hand-arm vibration The control of vibration at work regulations (L140)). The reported history of symptoms is the most useful diagnostic information. Additional standardised tests described in Tier 5 are an option. If these tests are conducted, the results will be considered by the doctor when arriving at a diagnosis of HAVS.

Tier 5 Use of standardised tests (Optional)

In addition to clinical findings from Tiers 3 and 4, standardised tests can be conducted at some sites or referral centres for a worker who has signs or symptoms of HAVS. This testing is aimed at providing a quantitative assessment, which is compared against “normal” data. If such testing is obtained, the final diagnosis of HAVS still depends upon the judgment of the doctor and will need to take account of the reported symptoms.

This tier is not required as part of routine health surveillance provision for a workforce exposed to HAV. It is considered to be potentially useful for studying the progression of the disease.

Results from more than one of the following may be obtained:

Vascular tests:

- Finger rewarming after cold provocation test (CPT)
- Finger systolic blood pressure test (FSBP)

These two standardised tests measure different parameters, although both tests use a cold challenge to the hands or fingers. The method in the FSBP test measures systolic blood pressure in the digital arteries, whereas finger rewarming times reflecting blood flow post cold challenge, are measured in the CPT. The result from the CPT is more likely to be affected by a number of factors, including the emotional state of the individual, due to the relatively large influence of the sympathetic nervous system.

Some researchers using the standardised test methods are concerned about the repeatability of the CPT in control subjects, i.e. abnormal (positive) results can appear in repeat tests in individuals with no history of symptoms of Raynaud's disease or HAVS. Other reservations have been expressed about the robustness of the FSBP test. Currently there is no consensus among UK testing practitioners on a vascular test that is sufficiently robust to be recommended for diagnosis of HAVS in a worker undergoing health surveillance.

Sensorineural tests:

- Vibrotactile perception threshold (VPT)
- Thermal (temperature) perception threshold (TPT)

These tests are considered to be useful in evaluating changes in perception that relate to loss of function if the disease has progressed. They can be used as an important part of the fitness for work decision (see **Classification of symptoms using the Stockholm Workshop scales and methods for dividing stage 2 and Management of affected worker, including fitness for work**).

Details of the test methods can be found in HSE *Contract Research Report CRR 197/98 "Standardised diagnostic methods for assessing components of the hand-arm vibration syndrome"* by Lindsell and Griffin. It should be noted that test conditions and methodology need to be carefully controlled.

Symptoms that may relate to carpal tunnel syndrome may need to be investigated by nerve conduction tests. This will usually follow referral to the patient's general practitioner.

Management of the affected worker, including fitness for work

Any worker diagnosed as suffering from HAVS will need to receive advice about their medical condition, and the likelihood of disease progression with continued exposure, from the doctor. The advice will vary according to the severity of the disease. HAVS is classified according to severity in stages (1-3) using the Stockholm Workshop scales (see **Classification of symptoms using the Stockholm Workshop scales and methods for dividing stage 2**). Continuing exposure may be acceptable in early cases. Diagnosis of new cases of HAVS (stage 1) should result in appropriate steps being taken by the employer to review the risk assessment and ensure that exposures are reduced to as low a level as is reasonably practicable. If exposure is adequately controlled, it may be possible to prevent workers with HAVS stage 1 from progressing to HAVS stage 2 before they reach retirement age. Health surveillance monitoring for the individual may need to take place more frequently, depending on the advice of the doctor, if there is concern about progression of the disease. The clinical assessment questionnaire can be modified so that a shortened version is used for repeat assessments.

Even if the employee does not give consent for medical information to be disclosed to the employer, it is the responsibility of the doctor to advise the employer on whether the worker is fit for work with exposure to HAV. A recommendation may need to be made on safety grounds. For example, significant loss of grip strength might increase the risk of accidental injury to the employee or their co-employees. In most cases, the main reason for judging a worker to be unfit for work with HAV is to prevent further deterioration that could cause disability.

If an employee is diagnosed as having HAVS stage 2 (sensorineural or vascular) the aim is to prevent HAVS stage 3 developing because this is a more severe form of the disease associated with significant loss of function and disability. At the onset of

symptoms of HAVS stage 2, there should be a reassessment of exposure conditions and close monitoring of the individual for any progression of symptoms, especially functional impairment. Detailed recording of reported symptoms will be important. The doctor should start to consider whether the employee is unfit to continue with exposure as soon as there is evidence that symptoms are progressing within HAVS stage 2.

One difficulty is that the tests of function used in the clinical assessment are not likely to give a clear indication of early functional loss. Stage 2 is broad, ranging from relatively minor symptoms to those with persistent loss of perception. Ideally, the worker will only be declared unfit when the disease has reached “late” stage 2. Some optional standardised sensorineural tests (vibrotactile perception threshold and thermal perception threshold tests) were described in the “Level 5” section. If the *doctor* decides to use these standardised tests, the results can be used to help assess the severity of the HAVS in stage 2 to assist the decision on whether “late” stage 2 has been reached.

A method for dividing HAVS stage 2 into “early” and “late” forms using these results from two sensorineural tests and an assessment of vascular symptoms is described in **Classification of symptoms using the Stockholm Workshop scales and methods for dividing stage 2**. Dividing sensorineural HAVS stage 2 in the absence of the standardised test results relies upon categorising numbness/tingling symptoms as “intermittent” or “persistent”. This will be less effective. Progression to the “late” form of stage 2 is a strong indicator of the employee being unfit for work with HAV. However, the available methods for assessment and prediction of progression are not necessarily precise, therefore the decision to advise the employer that a worker is unfit for work with HAV involves a significant element of clinical judgement.

Management of existing cases of HAVS stage 2 and stage 3 is potentially different as more information may be available about the rate of progression over time. An older employee, close to retirement age, with no indication of recent rapid progression of symptoms, and who fully understands the risks involved in ongoing exposures, may be allowed to continue work with limited exposure under regular health surveillance.

If carpal tunnel syndrome is diagnosed, the worker may need to be removed from exposure to vibration. Where a non-occupational condition is suspected, the employee should be referred to their general practitioner. Outcome of surgical decompression in carpal tunnel syndrome can be less favourable in HAVS patients than in people with no history of vibration exposure. Recommendations for return to work with exposure to vibration should be made on an individual basis and the employee should be informed of the possible return of symptoms with continued exposure.

When a recommendation is made by the doctor that an employee is no longer fit for exposure to vibration, the employer has to decide on the appropriate action to take. Factors such as the scope for further reductions in exposure and availability of other work with no exposure to vibration may play a part in this decision-making process. For the employee, there may be several obstacles to getting another job which does

not involve exposure to vibration. These might include the need to acquire additional training and skills, economic, social and cultural factors and an inability to work outdoors.

In addition to the requirement to supply individual fitness data, anonymised grouped results of health surveillance should, where practicable, be divulged to the employer by the occupational health professional and be used as a basis to assess the adequacy of vibration risks controls. In the case of large groups, individual consent is not required for this and the data should be given to the employer, but where the group of employees is small, confidentiality will have to be addressed. If standardised test results are obtained (see **Tier 5 Use of standardised tests (Optional)**), these may be useful in monitoring any changes in the severity of HAVS in groups of employees.

Clinical assessment for HAVS

This section of the guidance covers many of the details of how to carry out a clinical assessment for HAVS and will assist the occupational health professional when completing the recommended *clinical questionnaire*. The process of assessment relates to Tiers 3-4 and is normally carried out by an occupational health nurse and occupational physician.

A comfortable or warm room temperature, preferably without wide variations in temperature, is recommended for the clinical examination. The individual's history of symptoms and any relationship with the person's work needs to be recorded. The questionnaire contains a free text area to record responses at the start of the interview. Open questions such as "Do you have problems with your hands?" might be asked while leading questions need to be avoided in order to allow the individual to explain in their own words.

Hand symptoms

Symptoms of HAVS were described in **What are the clinical effects?** but some additional information is given here.

Tingling and numbness may occur as part of a normal physiological response to the use of vibrating tools. If this response lasts more than 20 minutes it is more likely to be part of a pathological process. Numbness is also associated with vasospasm. Numbness occurring separately from blanching is of prime interest as this may indicate the neurological component of HAVS. Tingling in HAVS is usually worsened by cold exposure. Symptoms of tingling or numbness in the fingers at night or on arm elevation may indicate carpal tunnel syndrome. The latter is a peripheral nerve disorder that can be caused by exposure to HAV. It is characterised by:

- Median nerve distribution of tingling and pain
- Being woken at night by hand symptoms such as pain or numbness
- Pains in the wrist radiating into the forearm
- Median nerve distribution of blunting of sensation
- Positive Tinel and Phalen's tests (see **Examination**)

- Wasting of abductor pollicis brevis in more severe long-standing cases

Subjects may volunteer that certain actions such as flicking or shaking the hands relieves symptoms of carpal tunnel syndrome. More diffuse symptoms of tingling and a complaint of a weak grip would tend to favour HAVS. (A weak grip is not normally a feature of carpal tunnel syndrome until the condition is well advanced).

There should be sufficient detailed description of the attacks of blanching to differentiate between abnormal arterial vasospasm (sometimes known as Raynaud's phenomenon) and a normal physiological response to cold. Vasospasm that reflects the vascular component of HAVS causes whiteness initially affecting the tips of the digits and then extending proximally to the palm. The whiteness is usually circumferential and there will be a "sharp" line of demarcation between normal and abnormal skin colour. Blotchiness or diffuse paleness of the skin is not what is meant by blanching in this context. Whiteness is often but not always followed by blueness and redness due to the hyperaemic phase.

Blanching attacks are more likely to occur in the winter months because cold is the main trigger. "Attacks" lasting many hours or days are not related to abnormal vasospasm since the latter are known to last about 20-60 minutes. "At other times?" on the questionnaire might refer, for example, to emotion acting as a trigger. Whiteness in the toes/feet is more likely to indicate primary Raynaud's phenomenon (Raynaud's disease) although there is a possibility that exposure to vibration can affect non-exposed extremities in HAVS cases where fingers blanch. Blanching with a more diffuse demarcation of whiteness in a distinct ulnar distribution may indicate the relatively rare hypothenar hammer syndrome and should be investigated further for possible treatment. This syndrome is usually associated with specific work activities or tool use. Blanching due to HAVS may only rarely be witnessed by the occupational health professional. It is unethical to actively attempt to trigger an attack by cooling the hands and, in any case, such attempts are often not successful. It may be useful to show a photograph of a typical example of an attack of blanching to the worker.



Difficulties may be experienced for example when fastening buttons or manipulating small objects which may result from areas of reduced sensitivity in an individual suffering from the neurological component of HAVS. It is important to ascertain if this is during attacks of blanching or if it occurs when the fingers are warm and the person is in a warm environment. The individual should be asked about the type of activities interfered with, the type of problem and whether interference only occurs in cold weather or continues throughout the year.

Musculoskeletal symptoms in the upper limb may be caused by risk factors such as working posture and not HAV per se, or by a combination of vibration exposure and handling heavy tools while applying a large grip force.

Occupational history

The leading hand is the hand nearest to the source of vibration, if this can be identified. It should not be assumed that this hand will be worse affected as cases will vary and depend on the variety of jobs, hand positions and tools used. All activities involving exposure to HAV are relevant. The 'trigger' or contact time is the estimated time for which the hands are actually exposed to vibration. This will often be considerable shorter than the period during which the tool is said to be used.

Some chemical agents are neurotoxic and may cause neurological symptoms similar to those of HAVS. Those encountered in the workplace may include:

arsenic	mercury compounds
antimony	methylbutyl ketone
acrylamide	n-hexane
carbon disulphide	some organophosphates
diethyl thiocarbamate	thallium
lead (inorganic)	TOCP

Social history/ leisure pursuits

Use of motorcycles should be included in leisure activities. Sources of vibration exposure and approximate 'trigger' times need to be recorded. Occasional use of DIY tools is not likely to be relevant.

Medical history

Any injuries or surgery to the hand, arm or neck will need to be considered as part of the clinical assessment.

Vascular symptoms of HAVS (Raynaud's phenomenon) may arise spontaneously in the general population from a variety of causes including Raynaud's disease (primary Raynaud's phenomenon) which affects about 3% of men and about 10% of women. As part of differential diagnosis of HAVS, it is appropriate to address whether there is reasonable certainty that the person does not have Raynaud's disease. Factors in favour of Raynaud's disease include:

- Early age of onset (teens or twenties)
- Usually a description of other cold extremities (ears, feet, nose)
- Symmetrical pattern of blanching
- Family history

Raynaud's phenomenon other than primary Raynaud's is known as "secondary" Raynaud's phenomenon. A number of other conditions are listed below that lead to a tendency to report similar vascular symptoms to those of HAVS, i.e. secondary Raynaud's phenomenon. In fact, many of these conditions are associated with a complaint of cold extremities and do not cause arterial vasospasm. It may be difficult to separate the symptoms which might arise from the effects of ageing on skin blood flow from those which may arise from HAVS. The list of conditions is not exhaustive:

- atherosclerosis
- cervical rib
- CREST syndrome
- dermatomyositis
- hyperfibrinogenaemia
- hypothyroidism
- leukaemia
- polyarteritis nodosa
- polycythaemia rubra vera
- rheumatoid arthritis
- scleroderma
- systemic lupus erythematosus
- the presence of cold haemagglutinins
- thoracic outlet syndrome
- thrombo-embolic disease
- vasculitis
- vasculopathy in diabetes

A few drug treatments and toxins are associated with symptoms of secondary Raynaud's phenomenon:

- beta blockers
- bleomycin
- ergot
- methysergide
- vinblastine
- vinyl chloride

The symptoms attributed to the neurological component of HAVS may arise from some medical conditions. These include:

- alcoholic peripheral neuropathy
- carpal tunnel syndrome (see **Hand symptoms**)
- cervical spondylosis (where one root is affected on one side)
- diabetic peripheral neuropathy
- hemiplegia

- multiple sclerosis
- neurofibromatosis
- poliomyelitis
- spinal cord compression
- syringomyelia

Drug treatment can sometimes cause neuropathy. For example:

- chloramphenicol
- cyclosporine
- ethambutol
- gold
- indomethacin
- isoniazid
- metronidazole
- nitrofurantoin
- perhexiline
- phenytoin
- polymyxin
- streptomycin
- vincristine

In addition, a number of chemicals in the workplace can cause peripheral neuropathy (see “**Occupational history**”).

Examination

A limited clinical examination is carried out to include the items mentioned on the clinical questionnaire form (see **clinical questionnaire**).

If a neuropathy is suspected from an examination of the hands and/or medical history, an examination of the feet is necessary and a check for an autonomic neuropathy should be made. If pulse or blood pressure is reduced in either arm, evidence of a subclavian bruit should be sought.

Allen’s test examines the patency of the palmar arches and digital arteries. Normal anatomical variations may give rise to false positive results in this test. The examiner, standing, uses the fingers of each hand to compress the radial and ulnar arteries at the wrist and then raises the subject’s hand while the subject opens and closes the hand to empty the palmar arches and subcutaneous vessels. The hand is then lowered and one of the arteries released. Prompt flushing of the hand indicates a normal contribution from the tested artery. Faint and delayed flushing of the fingers indicates that either the deep palmar or the digital arteries are occluded. A delay of more than five seconds indicates digital artery occlusion.

Light touch can be elicited using cotton wool and superficial pain using a sterile pin or broken orange stick but the high inter-observer error makes these procedures of little value in practice and they are not recommended. Monofilaments, such as Semmes-Weinstein monofilaments, can be used to test perception of light touch and

deep pressure. The testing kit consists of probes of varying thickness of nylon, which are presented to the subject until the probe deforms at a defined force. Recognition is recorded in a standardised way and the test should be performed with the subject having no visual clues to the application of the monofilaments.

The Purdue pegboard can be used to help assess manipulative dexterity and tactile sensibility. The test instructions should be followed and an assessment made separately for each hand. An alternative system, the nine-hole peg test, can also be used but is likely to give less adequate information. Both systems have normative data available. If these tests are not available, qualitative assessment can be made using a selection of small coins, washers or bolts. Deficit in manual dexterity associated with **severe** cases of the neurological component of HAVS is usually evident during medical interview in the manner in which the subject handles pieces of paper, uses a pen and grasps and turns door handles.

Adson's, Tinel's and Phalen's tests are available for use where appropriate:

Adson's test is only necessary where the history of positional symptoms points to thoracic outlet syndrome. During deep inspiration, with the head rotated to the side being tested and the arm abducted, the radial artery at the wrist is palpated. In the presence of subclavian obstruction, the radial pulse is reduced or absent. The false positive rate is about 10%.

Tinel's and Phalen's tests are used to elicit symptoms indicative of carpal tunnel syndrome and are therefore appropriate to use when the subject complains of tingling in the fingers in the median distribution. For a description of carpal tunnel syndrome see under numbness/tingling in the earlier section on "Hand symptoms". For Tinel's test, the subject's hand and forearm are rested horizontally on a flat, firm surface with the palm uppermost. The examiner places his/her index finger over the carpal tunnel at the wrist and applies a sharp tap to it with a tendon hammer. A complaint of tingling in the subject's fingers in the median nerve distribution is indicative of carpal tunnel syndrome. In Phalen's test, the subject raises his/her arms to chin level and then allows both hands to flex at the wrist by gravity. This posture should be maintained for three minutes. Tingling in the fingers in the median nerve distribution is indicative of compression of the median nerve under the carpal ligament.

Grip strength should be tested using a dynamometer. A standard handle position is usually used for each test. Standardised protocols have employed

- The subject seated, shoulder adducted, neutral rotation, elbow flexed at 90 degrees and the arm unsupported
- Standing while lowering the arm from the outstretched horizontal position, ensuring that the dynamometer does not touch the thigh.

The average result from three attempts in each hand should be recorded.

The final page in the questionnaire gives space to record the overall results of the assessment. The Stockholm Workshop scales should be used to classify vascular and sensorineural symptoms. This classification scheme is explained in the next

section. Results from any further investigations can be recorded on the form. It may be appropriate to obtain further test results from standardised methods (see tier 5 Standardised tests (Optional) Link required) and to divide any stage 2 cases of HAVS into “early” and “late” (see **Classification of symptoms using the Stockholm Workshop scales and methods for dividing stage 2**). For details on how to make a recommendation on fitness for work, (see **Management of the affected employee, including fitness for work**).

Classification of symptoms using the Stockholm Workshop scales and methods for dividing stage 2

The classification scheme known as the Stockholm Workshop scales should be used to classify neurological and vascular symptoms (Table 1). One disadvantage of the scales is the lack of precise definition for some of the terms used (e.g., “frequent”).

Table 1 Stockholm Workshop scales

Vascular component		
<i>Stage</i>	<i>Grade</i>	<i>Description</i>
0		No attacks
1 _V	Mild	Occasional attacks affecting only the tips of one or more fingers
2 _V	Moderate	Occasional attacks affecting distal and middle (rarely also proximal) phalanges of one or more fingers
3 _V	Severe	Frequent attacks affecting all phalanges of most fingers
4 _V	Very severe	As in stage 3, with trophic changes in the fingertips
Sensorineural component		
<i>Stage</i>	<i>Description</i>	
0 _{SN}	Vibration-exposed but no symptoms	
1 _{SN}	Intermittent numbness with or without tingling	
2 _{SN}	Intermittent or persistent numbness, reduced sensory perception	
3 _{SN}	Intermittent or persistent numbness, reduced tactile discrimination and/or manipulative dexterity	

Note: The staging is made separately for each hand. The grade of disorder is indicated by the stage and number of affected fingers on both hands, e.g. stage/hand/number of digits.

A system for allocating a weighted numerical value to each phalange affected and calculating an overall score for finger blanching in each hand is used in the Griffin method (Figure 1). This system is a useful method in practice for monitoring progression or regression of symptoms in individual fingers. It does not take account of the frequency of attacks, which may be more relevant in assessing functional disability. Some attacks can lead to a variable degree of blanching. In this case the worst distribution should be recorded.

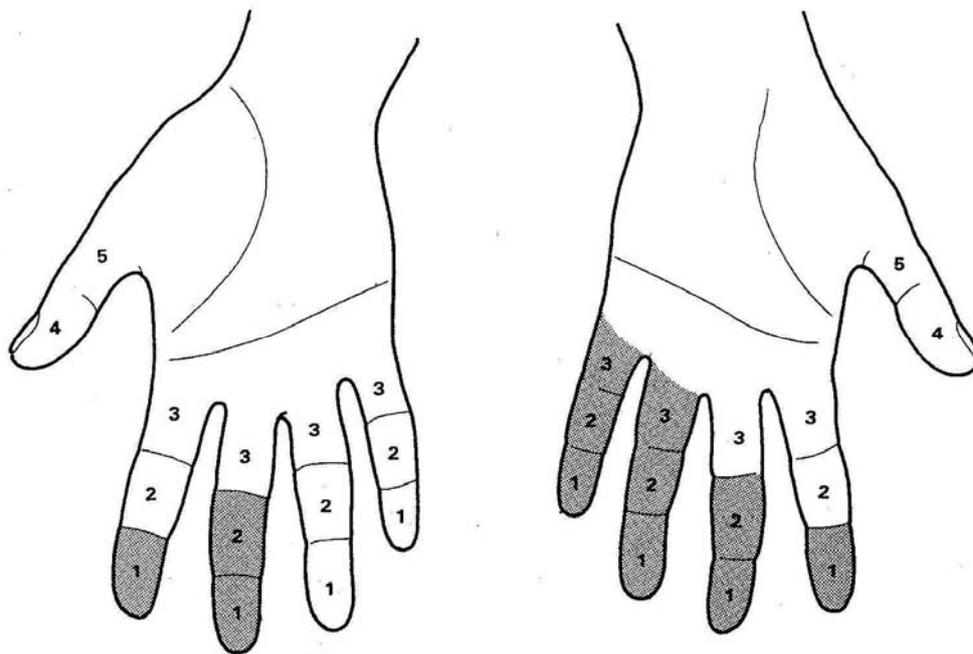


Figure 1 Numerical scoring of vascular symptoms of HAVS (after Griffin, 1982)

In the numerical scoring system for vascular HAVS, the blanching for each part of each digit is given a score as indicated on the diagram in Figure 1. A total value for each hand can be arrived at by summing the digit scores. In the figure, the score for the left hand is 16 and that for the right hand is 4.

If an employee is diagnosed as having stage 2, the aim is to prevent stage 3 (vascular or sensorineural) developing because this is a more severe form of the disease associated with significant loss of function and disability (see **Management of the affected employee, including fitness for work**). Stage 2 sensorineural is broad, ranging from minor neurological symptoms to those with persistent sensorineural loss. Therefore stage 2 should be divided into “early” and “late” phases in order to assist with management of stage 2 cases.

Lawson and McGeoch have published a method of adapting the Stockholm workshop classification scheme in order to divide stage 2. They have used the sum of the scores from two standardised sensorineural tests to divide the sensorineural stage 2 into “early” and “late”. The standardised tests are described in **Tier 5 Standardised tests (Optional)**. The scores relating to the vibrotactile perception threshold and thermal perception threshold tests are derived using the scheme given in Table 2. Numbness and tingling are given equal weighting in this adaptation.

Table 2 Scoring system for the standardised tests

Vibrotactile threshold test (index and little finger)

At 31.4 Hz	< 0.3 ms ² = 0	≥ 0.3 ms ² , < 0.4 ms ² = 1	≥ 0.4 ms ² = 2
At 125 Hz	< 0.7 ms ² = 0	≥ 0.7 ms ² , < 1.0 ms ² = 1	≥ 1.0 ms ² = 2

Thermal perception threshold test (1 °/second, index and little finger)

Temperature neutral zone	< 21 °C = 0	≥ 21 °C, < 27 °C = 2	≥ 27 °C = 4
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Reduced sensory perception can be assessed by the use of Semmes-Weinstein monofilaments and reduced manual dexterity by the Purdue pegboard as described in the “Clinical assessment for HAVS” section. If a loss of dexterity in a warm environment is diagnosed, and the total score for the two sensorineural tests is 9 or higher, then a score of 10 is added to this result but only if the Purdue pegboard result is abnormal. Hence the scoring criteria for stage 3 sensorineural is 19 or above in Table 3. The terms “intermittent”, “persistent” and “constant” are defined by Dr Ian Lawson to help differentiate between stage 2 “early” and “late” and stage 3 (see Table 3).

If no standardised test results are obtained, the process of dividing stage 2 sensorineural relies upon whether symptoms of numbness/tingling are intermittent or persistent, and will be less effective as a consequence.

In order to separate “early and “late” stage 2 vascular, the terms “occasional” and “frequent” are defined by Dr Ian Lawson and Griffin blanching scores are used (Table 3).

Table 3 Guide to sensorineural and vascular staging

Sensorineural

STAGE	CRITERIA	ASSESSMENT	
		Left Hand	Right Hand
0 sn	Vibration exposure but no symptoms		
1 sn	Intermittent numbness and/or tingling (with a sensorineural, sn, score of > 3 and < 6)		
2 sn (early)	Intermittent numbness, and/or tingling, reduced sensory perception (usually an sn score of ≥ 6 < 9)		
2 sn (late)	Persistent numbness, and/or tingling, reduced sensory perception (usually an sn score of ≥ 9 ≤ 16)		
3 sn	Constant numbness and/or tingling, reduced sensory perception and manipulative dexterity in warmth (and an sn score ≥ 19)		

Vascular

STAGE	CRITERIA	ASSESSMENT	
		Left Hand	Right Hand
0 v	No attacks		
1 v	Attacks affecting only the tips of the distal phalanges of one or more fingers – usually a blanching score of 1 - 4		
2 v (early)	Occasional attacks of whiteness affecting the distal and middle (rarely also the proximal) phalanges of one or more fingers – usually a blanching score of 5 - 9		
2 v (late)	Frequent attacks of whiteness affecting the distal and middle (rarely also proximal) phalanges of one or more fingers - usually a blanching score of 10 -16		
3 v	Frequent attacks of whiteness affecting all of the phalanges of most of the fingers all year – usually a blanching score of 18 or more		
4 v	As 3v and trophic changes		

Definitions;

- Intermittent - not persistent
- Persistent - lasting > than 2 hours
- Constant - present all of the time
- Occasional - 3 or < attacks per week
- Frequent - > 3 attacks per week

It should be realised that this scheme is indicative. In some individual cases, occupational health professionals may need to use their professional judgement to allocate the individual to “early” or “late” stage 2.

Treatment

Therapeutic interventions

Therapeutic interventions for HAVS are of limited benefit. Those suffering from HAVS are advised to keep their hands, feet and body warm by reducing their exposure to cold and wearing appropriate clothing. This may include weatherproof clothing, headwear and insulated gloves and boots. The use of chemical heat packs in gloves or boots, breaks taken in a warm environment and the use of hand driers blowing warm air on the hands during breaks are likely to be beneficial. Some benefit may be obtained by abstaining from smoking. Reducing noise exposure might also assist in reducing the frequency of blanching.

Pharmaceutical agents for the treatment of HAVS

The evidence for the effectiveness of pharmaceutical agents in the treatment of the vascular symptoms of HAVS is limited. No studies showing long-term benefits have been published, and much of the evidence is based upon treatment given for the vascular symptoms when these arise from causes other than HAV (e.g. Raynaud’s disease).

Calcium antagonists, alpha-adreno receptor antagonists, antifibrinolytics and prostenoids have all been used to treat the vascular symptoms of HAVS. However, a beneficial response is commonly associated with significant side effects. The most commonly used drug is Nifedipine: patients may find the side effects of ankle swelling, headaches and blushing unacceptable, although these may be reduced by using modified release preparations. Prostaglandin analogues have also been used, but this usually requires in-patient stay for several days to receive intravenous infusions. Significant side-effects, including hypotension, may restrict the dose given, which may reduce the effectiveness of the drug. Any improvement in symptoms is normally temporary. In general, the use of prostaglandin analogues is not appropriate.

No pharmaceutical treatment is available for the neurological component of HAVS.

Surgical interventions for HAVS

Sympathectomy, in one of its forms, has been used to treat Raynaud's disease. Usually a major improvement in symptoms can be achieved but only for a limited period of time. Sympathectomy for Raynaud's disease is best reserved for those individuals who appear to be heading towards irreversible digital gangrene, in whom it may delay the progression of the disease. Operative sympathectomy for Raynaud's phenomenon in HAVS can rarely, if ever, be justified. Digital sympathectomy has rarely been employed in patients with vasospastic symptoms of HAVS. The technique does receive limited support in the surgical literature for providing some benefit to patients with chronic digital ischaemia although the benefit is temporary in many cases. Many patients studied have had progressive collagen vascular disease. The technique has not been assessed on an isolated group of patients having vibration- induced vasospasm. This therapeutic approach cannot currently be justified in patients with circulatory problems arising from HAVS. Sympathectomy in the hand can be achieved pharmacologically by using a regional block. However, this is temporary in its effect and it probably has no application to HAVS.

Overall, the role of a sympathectomy in Raynaud's disease is extremely limited and in HAVS there can be very few occasions, if any, when its use is justified.

The management of carpal tunnel syndrome in association with HAVS

There is considered to be an approximate doubling of risk of carpal tunnel syndrome in people exposed to HAV. A patient's history may be consistent with the neurological component of HAVS and also carpal tunnel syndrome. Surgical decompression of the carpal tunnel in such circumstances has been shown to be an effective intervention in relieving symptoms of carpal tunnel syndrome. Carpal tunnel decompression in patients not exposed to HAV, generally produces a very favourable outcome. The results of carpal tunnel decompression in those suffering from HAVS is probably less satisfactory, but still worthwhile.

Acknowledgement

HSE acknowledges the contribution of the Working Group on Hand-transmitted Vibration of the Faculty of Occupational Medicine of the Royal College of Physicians and the Medical Assessment Process of the Department of Trade and Industry.