LECTURE 04

Effects on Human Body: Vascular System
Work with vibrating machines

Health hazards:

- Hand-arm vibration syndrome
- Vibration-related upper extremity disorders
- Work-related musculoskeletal disorders
- Stress-related health effects
- Noise-related hearing loss
- Dust-related lung disorders
- Vapour-related skin or mucous disorders.
Hand-arm vibration syndrome (HAVS)

- Shift in vascular function “Vibration White Fingers” (VWF)
- Shift in neurosensory function
- Shift in musculoskeletal function

Collectively addressed as: “Hand-arm vibration syndrome” (HAVS)
Vibration and the upper extremity

Red colour indicate area under impact of vibration.
Temporary vascular effects

Vibration source:

- Close effects
- Remote effects
Permanent effects: Vibration white fingers “VWF”

“Secondary Raynaud's Phenomenon”

Reduced sensibility
No bleeding during episode
Well demarked pallor
What goes wrong?

Normal

Vasospastic reaction

Raynaud’s phenomenon

Warm → Cold

Warm → Cold

White skin colouring

Patent blood flow of deep branches
Regulation of the peripheral vascular system

Central Autonomic system

Stress
Noise
Emotion

Temperature
Vibration

Local: endothelial
Vascular system of the upper extremity
Who is at risk for VWF?

- Exposed to vibration?
- Within latency time to contract symptoms?
- Are some people more susceptible?
- What about age?
- What about the use of tobacco?
- What about climate?
What could elicit the vascular symptoms?

- Exposure to cold
- Exposure to cold damp, high humidity and water
- Stress
- Vibration
- Local pressure and stress on the hands
What modifies the vascular symptoms?

- Time of day
- Stress level
- Nutrition
- Nicotine use
- Metabolic activity
- Blood pressure
- Medication
Possible disability and handicap

- Difficulty in performing manual tasks
- Difficulty in withstanding cold and damp
- Difficulty in withstanding exposure to vibration
- Difficulty in withstanding stress
- Restrictions due to pain, or loss of function
What will the physician do?

- Assess occupational and medical history
- Assess physical examination status
- Assess laboratory tests
- Care for possible treatment and management
- Inform on:
  - prognosis
  - contributory factors
  - factors affecting improvement of symptoms
  - preventive measures
  - workers-compensation and litigation.
Assessment of the occupational history

- Vibration exposure
- Ergonomic exposure
- Other vasoactive exposures: (e.g. lead, polyvinyl chloride, stress)
Assessment of the medical history

- Symptom description
- Times and durations
- Other diseases
- Colour chart
- Medication
- Tobacco use
### Staging of the vascular symptoms (1)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-</td>
<td>No attacks</td>
</tr>
<tr>
<td>1</td>
<td>Mild</td>
<td>Occasional attacks affecting only the tip of one or more fingers</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
<td>Occasional attacks affecting distal and medial (rarely also proximal) phalanges of one or more fingers</td>
</tr>
<tr>
<td>3</td>
<td>Severe</td>
<td>Frequent attacks affecting all phalanges of most fingers</td>
</tr>
<tr>
<td>4</td>
<td>Very severe</td>
<td>Symptoms identified in stage 3 and addition trophic skin changes in the fingertips</td>
</tr>
</tbody>
</table>
Staging of the vascular symptoms (2)

Stage 1
Stage 2
Stage 3
Stage 4

Trophic skin
Assessment of physical status

In addition to a general screening the physical examination is specifically focused on:

- The appearance of the distal parts of the hands and fingers including possible scarring, trophies, or nail aberrations
- The peripheral vascular system
- Provocation tests of vascular patency
- The cardiovascular system
- Signs of other diseases associated to Raynaud's phenomenon
Assessment with laboratory tests

**Cold provocation tests**
Increased sensitivity of the peripheral vascular system as presented by episodes of white fingers is assessed by standardised cooling and measurement of re-warming or by comparison of distal blood pressure before and after cooling (Critical Opening Pressure).

**Chemical laboratory screening**
Because rheumatologic diseases are related to an increased risk of Raynaud's syndrome sedimentation rate could be used as one rough screening test.
Other causes of “white fingers”

- Primary Raynauds phenomenon
- Other diseases;
  - Obstructive vascular disease
  - Connective tissue disease
- Medication;
- Heart and blood pressure
- Asthma
- Other occupational exposures;
  - lead, vinyl chloride, arsenic
- Trauma or compression
Clinical evaluation of vascular symptoms

- Are the vascular symptoms consistent with secondary Raynaud's phenomenon?
- Are the vibration exposure characteristics consistent with hand-arm vibration syndrome?
- Are there any other confounding exposures?
- What stage should the symptoms be classified as?
- The demands on diagnostic precision depends on the aim of the investigation.
Management and treatment

- Primary prevention by exposure reduction.
- Secondary prevention by actions that could modify symptoms; reduce tobacco use, stress management, heating, nutrition, noise reduction, optimized work technique.
- Possible medical treatment restricted to specific cases.
- Documentation for workers compensation.
Prognosis for vascular symptoms

- Improvement after discontinued exposure to vibration
- Almost every other diseased could reach improvement
- The chance for improvement is higher for subjects with low stage classification, few exposure years and low age
- Continued tobacco use after cessation of exposure still results in an unfavourable prognosis