OCCUPATIONAL AND ENVIRONMENTAL HAZARDS

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GOAL

Overview of occupational and environmental hazards as they relate to Family Practice

KEY ISSUES

• Targeted medical history taking
• Using specialized resources
• Appropriate testing modalities
• Primary v. referral medical care

MOST IMPORTANT PROBLEMS IN OCCUPATIONAL INJURY AND ILLNESS?

<table>
<thead>
<tr>
<th>10 Leading Types – NIOSH (1983)</th>
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<tbody>
<tr>
<td>Lung</td>
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<tr>
<td>Musculoskeletal</td>
</tr>
<tr>
<td>Cancer</td>
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<tr>
<td>Cardiovascular</td>
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<tr>
<td>Skin</td>
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</table>
OCCUPATIONAL LUNG DISEASE

• Usual emphasis: Asbestosis, silicosis, coal workers’ pneumoconiosis

• Largely irrelevant to general practice...

A MORE RELEVANT CASE SCENARIO

A 24-year-old female presents with shortness of breath and cough.

She spent the morning cleaning a shower stall, first with a bleach spray and then, when that didn’t work, with a tile cleaner.

\textit{In situ} production of chlorine gas $\rightarrow$ mixing hypochlorite with acid

(many tile cleaners contain either: hydrochloric, phosphoric acid)
IN CONTRAST TO *CHRONIC OCCUPATIONAL LUNG DISEASE*

- Brief episode (can be repeated)
- Exposure levels are high
- Symptom onset right after exposure

LIMITED REPERTOIRE RESPONSE TO IRRITANT INJURY

- Mucous membrane irritation
- Burning eyes, runny nose
- Tracheobronchitis, hoarseness, cough
- Laryngospasm, bronchospasm
- Pulmonary edema, ARDS

COMMON EMPHASIS – TWO GROUPS OF INHALANTS

- *High solubility*...upper airway symptoms
- *Low solubility*..... deep injury

✓ Caveat: high solubility also → deep injury following ↑ exposure
CHLORINE GAS IS A GOOD EXAMPLE

- Chlorine → mucous membrane irritation
- With sufficient exposure, deep lung injury results (even though soluble)

Targeted History:
- Identify agent or exposure scenario
- Did symptoms start immediately?
- Note: can be on the job, domestic or environmental

Testing:
- Early PFTs, if symptomatic

Management:
- Bronchodilators, as indicated
- Follow-up for resolution of symptoms

FEBRILE INHALATIONAL SYNDROMES

- Metal fume fever:
  - Due to galvanized metal fume

- Organic dust toxic syndrome:
  - Heavy exposure to high levels of organic dust (shoveling moldy woody chips)
HEAVY METAL PNEUMONITIS

- Cadmium fume: flame-cutting previously soldered metal
- Mercury fume: can occur in the home refining of gold or home spills

✓ Severe illness with alveolar injury
✓ Caveat: This is not metal fume fever

OCCUPATIONAL ASTHMA IS A COMMON PROBLEM

- Synthetic, low-molecular weight chemicals (e.g., urethane)

- High-molecular weight, naturally occurring (e.g., animal dander)

- Irritant-induced (e.g., chlorine gas)

Targeted History:

- Very heavy exposure
- “Tachyphylaxis” with repeated exposure
- Note: Can be avocation (non-salaried work)

Testing:

- Only if a concomitant exposure suspected

Management:

- Self-limited: avoid future overexposure

Targeted History:

- Heavy exposure
- 8-24 hours previously

Testing:

- Chest imaging
- Pulse oxymetry

Management:

- Close observation for ARDS risk
THE KEY TOXICOLOGIC PRINCIPLE:
- Responses to sensitizers differ from non-specific irritants
  - If sensitized, even low levels → response
  - For irritant asthma, higher (irritant-level) exposures → not specific response

Targeted History:
- Work with 2-part product, natural sensitizer?
- Temporal association (Δ away from work?)
- Note: exposure can occur in hobbyists

Testing:
- Portable peak flow at work/off work
- Pre-exposure/post-exposure PFTs

Management:
- Complete removal: exposure from patient
- Complete removal: patient from exposure

Musculoskeletal Conditions
- Carpal tunnel syndrome
- Other entrapment neuropathies
- Chronic back, neck, lower ext. pain
Targeted History:
- Repetitive extremity use (torque, extension)?
- Mouse, keyboard?

Testing:
- Physical exam vs. electrophysiology

Management:
- Surgery is no substitute for work Δ’s
- Steroid injection, NSAIDs

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Acute Trauma

- Violence (convenience stores)
- Motor vehicle injury (deliveries)
- Power tools (agriculture)
- Falls (construction)
- Burns (restaurants)

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SPECIAL MENTIONS

- High pressure injection injuries (eg, from paint spray guns)
- False concern – systemic toxicity from the injected substance
- Nail gun injuries - also a ↑ problem
- Both can types of injury occur with rental equipment used by amateurs
Targeted History:
- Verify injury (non-dominant hand, cleaning)

Testing:
- Not indicated (early exam shows minimal Δ)

Management:
- Emergency referral to a hand surgeon

OCCUPATIONAL CANCER
- Major issue of public concern
- Acute exposures often raise inappropriate fears
- Chronic exposure risk difficult to assess in single individual

Selected Carcinogens RR>2.0

<table>
<thead>
<tr>
<th>Substance</th>
<th>Cancer</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td>Mesothelioma;</td>
<td>Construction, shipbuilding</td>
</tr>
<tr>
<td></td>
<td>Lung cancer</td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>Leukemia</td>
<td>Glue-work</td>
</tr>
<tr>
<td>Arsenic, Chromium</td>
<td>Lung Cancer</td>
<td>Metal working; smelter work</td>
</tr>
<tr>
<td>Vinyl Chloride</td>
<td>Angiosarcoma</td>
<td>PVC synthesis</td>
</tr>
<tr>
<td>Benzidine</td>
<td>Bladder Cancer</td>
<td>Dyestuffs</td>
</tr>
</tbody>
</table>
Selected Carcinogens RR≥1.5

<table>
<thead>
<tr>
<th>Substance</th>
<th>Cancer</th>
<th>Source</th>
<th>Risk</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radon</td>
<td>Lung</td>
<td>Uranium mining and milling</td>
<td>OR 5.0 for 200 WLM cumulative</td>
<td>OSHA: 4 WLM per year (64 in 14 years)</td>
</tr>
<tr>
<td>Radon</td>
<td>Lung</td>
<td>Residence</td>
<td>1.50 per 11 WLM for 14 yrs = 4 pCi/L average</td>
<td>EPA: Fix your home if radon level ≥ 4 pCi/L</td>
</tr>
</tbody>
</table>

WLM = Working level month

Targeted History:
- Verify chronicity, delineate latency
- Identify selected high risk exposures

Testing:
- No biomarkers used in routine testing

Management:
- Attribution is part of medical management
CARDIOVASCULAR DISEASE

- Carbon monoxide
- Carbon disulfide
- Nitrates (withdrawal coronary spasm)
- Tilmicosin (Micotil 300) cattle antibiotic

Targeted History – Do You Work With?:
- Combustion engine in closed space: power generator, power equipment (inc. propane) → CO
- Methylene chloride (furniture stripper) → CO
- Rayon manufacture → Carbon Disulfide
- Munitions → Nitrates

Testing:
- Workplace exposure levels (industrial hygiene)
- Carboxyhemoglobin level if CO suspected

Management:
- Work process changes to ↓ exposure

REPRODUCTIVE TOXICITY

- Heavy metals (lead and mercury)
- Hospital radiation/chemical exposures
- Dibromochloropropane [banned soil fumigant]
Targeted History:
➢ Focus on perceived and concrete risks

Testing:
➢ Not specific role, usually very low level
➢ Exception – heavy metals

Management:
➢ Temporary placement when feasible

NEUROTOXINS – PERIPHERAL NEUROPATHY

- Heavy metals: lead, arsenic, mercury
- Carbon disulfide
- N-hexane; 1-Bromopropane
- Certain organophosphates

NEUROTOXINS – CNS EFFECTS

- Pesticides
- Manganese
- Heavy metals
Targeted History:
- Often heavy exposure (skin contact, fumigation including bystanders, “industrial strength” formulations)
- Indoor residential sources possible (Hg, Pb): other family or pets ill?

Testing:
- Quantify effect (neuropsych tests, nerve conduction)
- Specific toxicological testing (metals, cholinesterase)

Management:
- Limited options except eliminate further exposure
- Be aware of “index case” presentation
- Beware of inappropriate treatments (e.g., chelation)

HEARING LOSS
- Noise is the major exposure
- Huge occupational health problem
- Pre-existing hearing loss may ↑ effects of common ototoxic drugs

Targeted History:
- Loud enough at work to have to shout to be heard

Testing:
- Audiometry
- Characteristic notch at ≈ 4 K hertz

Management:
- Adequate hearing protection
- Avoid superimposed ototoxins
DERMATOLOGICAL CONDITIONS

- Allergic and irritant contact dermatitis
- Contact urticaria
- Acute chemical caustic or acid injury
- Systemic direct toxicity usually not relevant; Exception → hydrofluoric acid

DERMATOLOGICAL CONDITIONS: Exception

HYDROFLUORIC ACID

Targeted History:
- Microelectronics work or rust removal agent (consumer product)
- Delayed onset, severe local pain

Testing:
- R/o systemic hypocalcemia if large exposure

Management:
- Calcium gluconate
PSYCHOLOGICAL DISORDERS

• “Post-traumatic stress syndrome”

• “Mass psychogenic illness”

• Chemical toxicant mechanisms are often invoked by those who are ill

THE NIOSH “TOP TEN” LIST IS INCOMPLETE

• Hepatotoxicity
• Renal disease
• Hematologic disorders
• Systemic syndromes
• Contentious or disputed conditions
• Emerging diseases
• Environmental disease

HEPATOTOXICITY

• Halogenated hydrocarbon solvents

• Dimethyl formamide; dinitropropane; hydrazine

• Toxicity is dose-dependent

• Contrasts to most medication-related hepatotoxicity

Targeted History:

➢ Focus on DSM criteria

Testing:

➢ Inappropriate toxicological testing is counterproductive

Management:

➢ Early psychodynamic intervention
Targeted History:
- Exposure proximally related to illness
- Recent change in process or job duties
- Skin contact, acute solvent effects (CNS)

Testing:
- Chemical hepatitis non-specific but...
- ALT:AST ratio > 1 suggests non-ethanol effect
- Fatty change *can be* toxin related

Management:
- Modify work practices

RENAL DISEASE
- Usually chronic (unless massive acute)
- Interstitial disease – heavy metals
- Glomerular - ? Hydrocarbon solvents
- Little in specific testing or management

HEMATOLOGIC DISORDERS
- Methemoglobin – Many oxidants
- Hemolysis – Arsine Gas
- Bone marrow toxicity – Benzene
**SYSTEMIC OR MULTI-ORGAN TOXINS**

- CO, cyanide, hydrogen sulfide,
- Dinitrophenol (DNP)
- Arsenic
- Disulfiram (Antabuse) reactions

**Targeted History:**
- Exposure followed rapidly by effect

**Testing:**
- Certain toxins can be identified specifically

**Management:**
- Any serious exposure will lead to hospitalization
- Sequelae non specific, anoxia-related
**CONTENTIOUS SYNDROMES**

- Mold-related, non-respiratory effects
- Electromagnetic field syndromes
- Multiple-chemical “sensitivity”

**“SICK BUILDING” SYNDROME**

- Complaints typically non-specific
- Often $\leftarrow$ inadequate air exchange
- Other factors: humidity, smells

✓ Caveat: Respiratory symptoms $\rightarrow$ suspect alternative dx [e.g., hypersensitivity pneumonitis]

**EMERGING DISEASES**

- Popcorn worker’s lung / diacetyl (bronchiolitis obliterans)
- Demyelinating polyneuropathy in pork processors
- Work-related rhinitis (same agents that cause occupational asthma)
- Newer infectious agents (SARS, H1N1 in health care and animal workers)

**BEYOND THE FACTORY DOOR**
BEYOND THE FACTORY DOOR

- Community Airborne Releases, e.g., radioactive gases
- Water Pollution, e.g., perchlorate
- Ubiquitous Environmental Chemicals e.g., bisphenol A
- Food Contamination, e.g., resistant bacteria
- Health Effects of Global Warming, e.g., unstable weather

Unless we consider the possibility of work-related (and environmental) risks when treating patients in a general care setting, there is no hope of identifying such factors in the etiology of disease.