

# Basic Course in Occupational and Environmental Medicine, Part III

## Orlando, Florida, October 30, 2011

### Occupational Cardiovascular Disorders

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Occupational Medicine Basic Course Part III  
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### Educational Goals and Objectives

- Define key terms, phrases and exposures relevant to occupational induced Cardiovascular disorders
- Discuss the health impact and the major causes of morbidity and mortality due to Cardiovascular occupational diseases
- Describe the features of Cardiovascular diseases: burden of illness, risk factors/etiology, prevention strategies
- Discuss the key components of an occupational evaluation and demonstrate the ability to utilize screening, diagnostic and monitoring modalities

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### Cardiovascular Disease Burden of Illness

- **PREVALENCE:**
- Affects >81 million American adults (more than 1 in 3)
  - 74,500,000 High BP
    - 33% of U.S. adults >20 have HTN
    - >43% of African American adults (among highest HTN rates in the world)
  - CHD 17,600,000
    - MI 8,500,000
    - AP 10,200,000
  - Heart Failure 5,800,000
  - Stroke 6,400,000
  - Congenital CV defects 650,000-1,300,000

**Circulation** Heart Disease and Stroke Statistics 2010 Update.

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### Cardiovascular Disease Burden of Illness

- **INCIDENCE:**
- Average annual rate to first CV event
  - Raise from 3/1000 in men from 35-44 y/o to 74/1000 at 85/94 y/o
- For women comparable rates occur 10 years later (gap narrows with increasing age)
- In men under age 75; most CVD events occur due to CHD
  - In women under age 75; most cardiovascular events are due to stroke*

**Circulation** Heart Disease and Stroke Statistics 2010 Update

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### Cardiovascular Disease Burden of Illness

- **MORTALITY:**
- Leading cause of death, CVD in 2006 accounted for 2300 deaths per day or 1 death/38 seconds
- CHD caused 1/6 deaths in the U.S. in 2006
- Estimates for 2010
  - 785,000 Americans will have their 1<sup>st</sup> coronary attack
  - 470,000 will have a recurrent attack
  - An additional 195,000 will have their 1<sup>st</sup> silent MI

**Circulation** Heart Disease and Stroke Statistics 2010 Update.

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### Cardiovascular Disease Risk Factors



- **Non-modifiable factors;**
  - Family history* (genetics and shared social/cultural environments)
  - Male* (age adjusted risk double in men)
  - Age* 55% of all MI's and 85% of all fatal ones occur in those 65+ years
  - Uncommon in premenopausal women & men <40

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### Cardiovascular Disease Risk Factors

- **Modifiable factors;**
  - a. Smoking:**
    - Adults who smoke die 13-14 years earlier than nonsmokers
    - 2- to 3-fold increased risk of dying of CHD
    - Mortality increases according to amount smoked
    - Risk for CHD is near normal within 2-3 years of quitting

Medical Costs \$96billion Lost Productivity \$97billion


**Circulation** Journal of the American Heart Association Heart Disease and Stroke Statistics 2010 Update 7



### Cardiovascular Disease Risk Factors

- **Modifiable factors;**
  - b. Elevated cholesterol and low-density lipoprotein**
    - For every 1% decrease in LDL-C, relative risk for major CHD events decreases by 1% (*Circulation*. 2004;110:227-239.)
    - <200 mg/dl results in low risk of middle age adults
    - At  $\geq 240$  mg/dl CHD risk doubles
    - Low risk associated with total cholesterol: HDL ratio < 3.5
    - Estimated responsible for >40% of CHD mortality


**Circulation** Journal of the American Heart Association Heart Disease and Stroke Statistics 2010 Update 8



### Cardiovascular Disease Risk Factors

- **Modifiable factors;**
  - c. High blood pressure**
    - Increased risk if SBP  $\geq 140$  and/or DBP  $\geq 90$
    - 69% of people who have a 1<sup>st</sup> MI have BP >140/90
    - Affects 33% of adult population in US
    - Estimated to be responsible for 30% of CHD deaths
    - Risk of ischemic heart disease reduced 2-3% for each mm hg decline in DBP


**Circulation** Journal of the American Heart Association Heart Disease and Stroke Statistics 2010 Update 9



### Cardiovascular Disease Risk Factors

- **Modifiable factors;**
  - d. Sedentary lifestyle**
    - Physical inactivity is responsible for 12.2% of the global burden of MI after accounting for other CVD risk factors
    - Responsible for 35% of CHD deaths
  - e. Obesity (reported as 33% for Mississippi)**
    - Age adjusted relative risk for cardiovascular disease 20 increase if overweight
    - increases 46% for men and 64% for obese women
    - Responsible for 13% of CVD deaths (2004)
  - f. Diabetes (increased risk of developing CVD 2-3 fold)**
    - CHD death rates are 2-4x higher for those with diabetes


**Circulation** Journal of the American Heart Association Heart Disease and Stroke Statistics 2010 Update. 10



### Cardiovascular Disease Primary Prevention Strategies

- × **a. Smoking**
  - Tobacco use prevention
  - Smoking cessation
- × **b. Physical Activity**
- × **c. Consumption of a healthy diet (low in fat and cholesterol)**
- × **d. Alcohol consumption**
  - Light consumption (< 2 drinks/day) reduced MI risk 25-45%
  - Must balance "other risks" associated with alcohol use

**Circulation** Journal of the American Heart Association Heart Disease and Stroke Statistics 2010 Update 11



### Cardiovascular Disease Primary Prevention Strategies (Insufficient evidence)

- **Aspirin prophylaxis:**
  - May prevent CHD in persons at increased risk (must weigh risks)
  - Slight increase in hemorrhagic CVA
- **Estrogen-replacement therapy:**
  - Risk of CHD reduced 45% in postmenopausal women
  - Risks of endometrial and breast cancer must be weighed

**Circulation** Journal of the American Heart Association Heart Disease and Stroke Statistics 2010 Update. 12

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### Return to Work Evaluations

- **Most Common evaluations;** post MI, CABG and angioplasty  
Rehabilitation includes Education, exercise and encouragement to RTW
- **Work disability after MI:** related to several personal variables  
Age, socioeconomic status, education, culture
- **Psychological factors:** stress, self-assessed health, depression, perception of work demands
- **Cardiac indicators;** angina, past MI, severity of AMI, LV function, exercise tolerance
- **Job related factors;** physical workload, financial incentives

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### Return to Work Evaluations Clinical Assessment

Main goal is to **SAFELY** increase RTW rates

- Dependant on extent of MI  
Uncomplicated sedentary work; RTW 2-4 weeks  
Uncomplicated strenuous work: RTW 4 weeks after symptom limited stress test
- All others RTW will be based on: physical exam, physical capabilities, exercise stress test, LV dysfunction on echocardiogram

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### Work and Demand

- U.S. Department of Labor  
– Classifies jobs from sedentary to very heavy depending on the energy expenditure required

PDL	HR	ENERGY
Sedentary	70-80	1.5-2.1 METS
Light	81-90	2.2-3.5 METS
Medium	91-110	3.6-5.5 METS
Heavy	111-130	5.6-7.5 METS
Very Heavy	130+	7.5+ METS

	METS
Sitting	1
Sweeping	1.5
Driving a car	2
Ironing	3.5
Showering	3.5
Bowling	3.5
Sex	3.7-5
Golfing	4
Gardening	4.5
Tennis	6
Lawn Mowing	6.5
Shoveling	7
Skiing	8

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### DOT Recommendations for RTW

- 1 week after elective PCI for stable angina
- 2 months after MI & no recurrent angina  
– ETT 4-6 weeks after MI pt should be able to
  1. achieve 6 METs (standard Bruce protocol)
  2. 85% of maximal HR
  3. LVEF >40% on echo
- 3 month waiting period after CABG

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### Occupational Cardiovascular Disease Complicating Factors

- Common in absence of occupational exposure
- Nonspecific
- Difficult to document toxic levels
- May be prolonged latency period
- Interaction among other risk factors



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### Evaluation of Patients

- Detailed occupational History
- Examine industrial hygiene data
- Evaluate other risk factors
- Perform complete Physical exam
- Diagnostic studies



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### Occupational Exposure Cardiotoxins

- Carbon Monoxide
- Carbon Disulfide
- Organic nitrates
- Solvents
- Miscellaneous



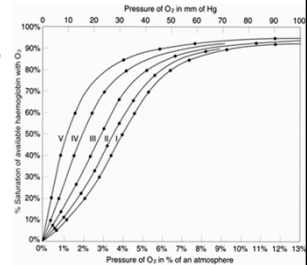
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### Carbon monoxide

#### High risk occupations:

Fork lift operator, foundry worker, miners, mechanics, garage attendants, firefighters

- Decrease delivery of oxygen
- Headache at levels <10% - may have nausea, fatigue, dizziness, dimmed vision at higher levels
- 20% Dizziness, nausea, and syncope, arrhythmias 25%
- 30% Visual disturbances
- 40% Confusion and syncope
- 50% Seizures and coma
- 60% Cardiopulmonary dysfunction and death



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### Carbon monoxide

- **Laboratory findings**, elevated carboxyhemoglobin
- **T1/2**: room air 4-6 hours, 60-90 minutes at 100% oxygen, < 25 minutes in hyperbaric chamber at 2atmos
- **ABG**: Likely to have normal PaO2, respiratory alkalosis, lactic acidosis
- **EKG changes**: associated with angina, delayed av conduction and ventricular repolarization
- **TLV**: 25ppm which is 2-3% concentration
- **Treatment**: removal, oxygen



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### Cardiovascular Abnormalities Carbon Disulfide

- **Used as solvent**; rubber and viscose rayon industries, pesticide mixed with carbon tetrachloride, ammonium salts, degreaser
- **Pathogenesis**: complexes with trace metals in the body and inhibits enzyme systems
  - Inhibits lipid metabolism leading to increased LDL
  - Disturbs thyroid function leading to hypothyroidism
- **CAD – seen after 5-10 years of exposure**
- **Reports of renovascular hypertension**

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### Clinical Findings

- **Acute intoxication**: encephalopathy, polyneuropathy, fatigue headaches, dizziness disorientation delirium
- **Disulfiram-like reaction**: inhibition of alcohol dehydrogenase
- **Skin contact**: erythema, pain, burns
- **Cardiovascular**: atherosclerotic disease, angina, MI, EKG-ischemia, delayed conduction
- **Diagnostic labs**: , serum thyroxine, LDL
- **Treatment**: removal from exposure may have improvement in retinal circulation, symptomatic treatment



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### Organic Nitrates

Ammonium, Sodium Nitrate, Ethylene Glycol Dinitrate, Nitroglycerin (Glyceryl Trinitrate), and TNT

- **Munitions workers**: explosive manufacturing, weapons handling
- 1950's epidemic of sudden death in young munitions workers after abrupt withdrawal from organic nitrate exposure who hand packed cartridges

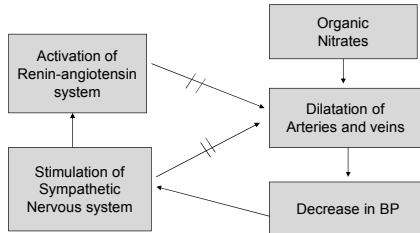
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### “Monday Morning Angina”

- **Pathogenesis:** Vasospasm typically occurs 2-3 days after last nitrate exposure



Adapted from *Current Occupational & Environmental Medicine* Fourth edition

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### Organic nitrates

- **Symptoms:** typical for Ischemic CAD
- **Labs:** EKG, CPK, Troponin I
- **Treatment:** Cardiac nitrates, Ca blockers
- **Other exposures:** “trinitrophenylmethylnitramine”

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### Case Presentation

- 14 y/o male is brought to the emergency room unresponsive by paramedics. He has paint around his mouth. Police state that they found some kids in a parking lot behind a building involved in suspicious activity. The boys started to flee when the police approached, all got away but this one who suddenly collapsed in the middle of an on foot pursuit. What happened?
  - Pneumothorax
  - Aspiration
  - Dilated cardiomyopathy
  - Boy was scared to death

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### Hydrocarbon Solvents Chlorofluorocarbons

- **Chlorohydrocarbon solvents:** Trichloroethane, trichloroethylene, methylene chloride
  - Dry cleaning, degreasing, painting, chemical manufacturing, refrigerants
- Heart is sensitized to catecholamine response and it lowers the threshold to arrhythmias
- Induce bradycardia by affecting SA node
- Depress AV nodal conduction causing AV block
- Prevention: engineering controls, restricting a worker with pre-existing heart arrhythmias from working with hydrocarbons
- **Treatment:** expect resolution when removed from exposure, monitor pulse ox for 6 hours, CXR, avoid use of epinephrine if arrhythmias present

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### Insecticides

#### Organophosphate & Carbamate toxicity

**Inhibits acetylcholinesterase:** Causes accumulation of acetylcholine and myoneural junctions

- **Nicotinic effects (acute poisoning)** Muscular fasciculation's, cramping, weakness, diaphragmatic failure, HTN, tachycardia, mydriasis and pallor, anxiety, confusion, tremors, ataxia, seizures coma

• **Muscarinic effects (later)** bradycardia, hypotension, bronchospasm, rhinorrhea, cough, hypersalivation, N/V/D, incontinence, myosis, blurred vision, lacrimation, diaphoresis

→ Asynchronous repolarization of different parts of the heart may lead to QT-interval prolongation and torsades de pointes.

• **Treatment:** decontamination, pralidoxime and atropine, avoid antiarrhythmics (slows conduction)



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### Heavy Metals and “Others”

- **Arsenic:** acutely can cause torsades de pointes, chronic exposure can cause “blackfoot disease” with claudication and gangrene
- **Arsine:** hemolysis - hyperkalemia → cardiac arrest
- **Cadmium:** peripheral arterial disease
- **Cobalt:** diastolic dysfunction on echo
  - Used to stabilize beer foam and caused 22% mortality rate in affected heavy drinkers secondary to myocardial necrosis
- **Lead:** HTN, fatal myocarditis

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Thank you!

