

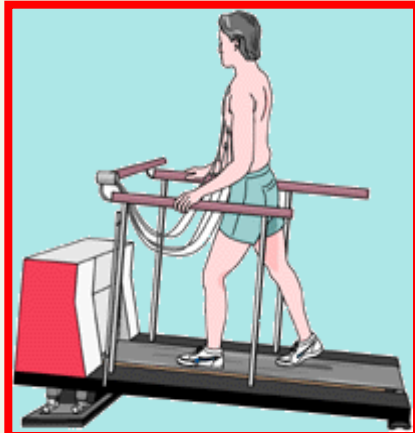
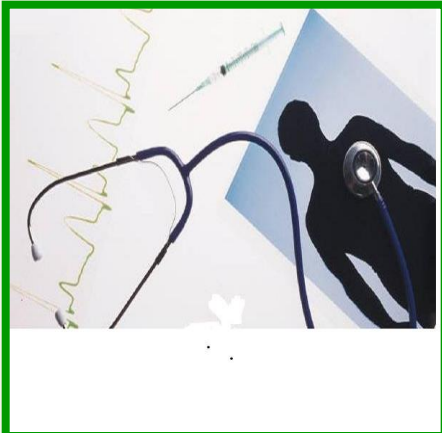
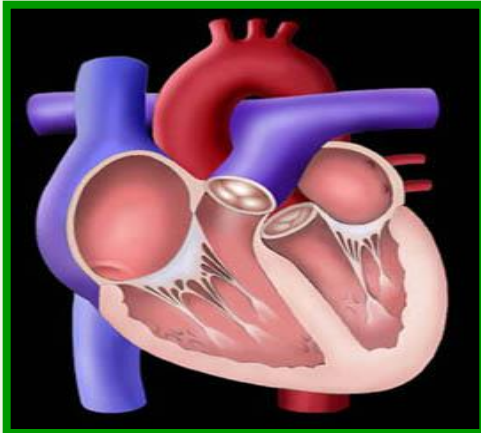




***In the name of
GOD***



Occupational Health and the Heart



دکتر میرسعید عطارچی

متخصص طب کار و بیماریهای شغلی

استاد دانشگاه علوم پزشکی گیلان

مرکز آموزشی پژوهشی درمانی رازی



Introduction



- Heart disease and stroke cause the majority of deaths in the world
- Major risk factor:
 - Family history, Hypertension, Diabetes, Lipid abnormalities, Smoking
- ❑ Other factors:
 - ✓ Stress,
 - ✓ Exposure to occupational or environmental toxic agent

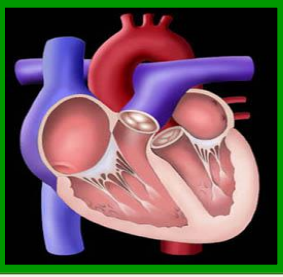




Introduction



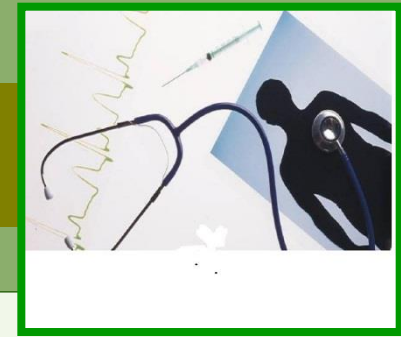
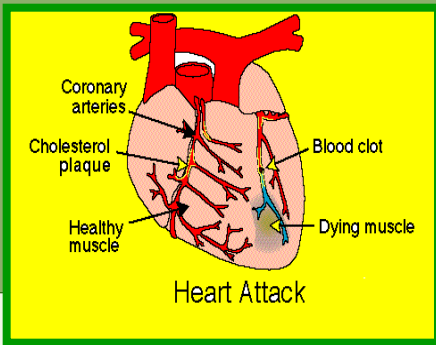
- The united states estimate that 1% to 3% of deaths from cardiovascular disease are work related.
- Note:
 - Preventable
 - Chemical
- Toxic cardiovascular disease is usually the result of chronic low level exposures.



Evaluation of patients



- Complete physical examination
- Occupational history:
 - Work, Job, Task
- Attempt to document exposure:
 - Industrial hygiene data & monitoring worker exposure
- Other risk factor



Agents can be grouped by main or major effects on the C.V.S

Coronary artery disease

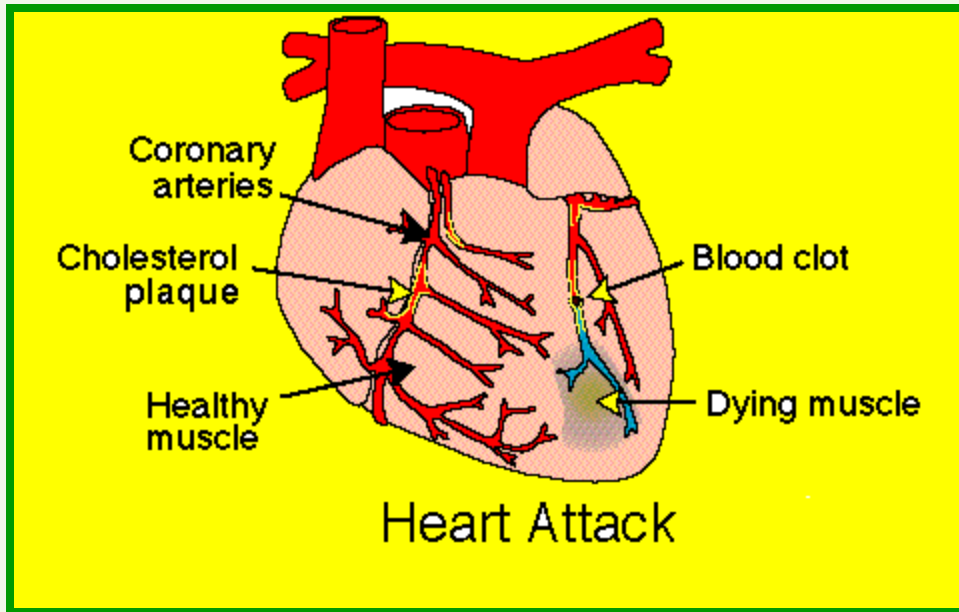
Dysrhythmias

Cardiomyopathy

Hypertension

Peripheral arterial disease

Coronary artery disease



***CAD** - Carbon monoxide*

Sources of incomplete combustion:

Furnaces, boilers

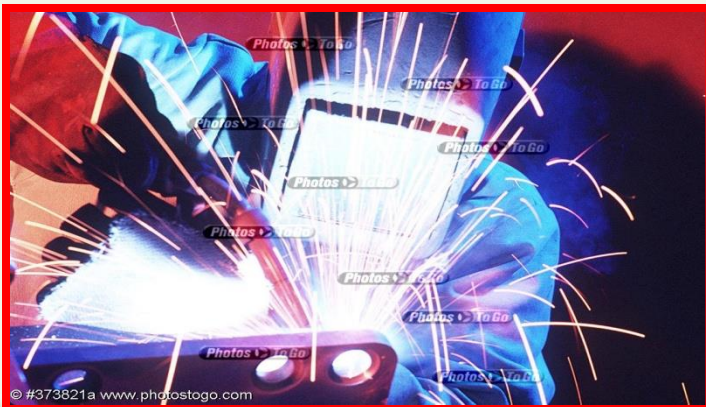
Internal combustion engine
(warehouses, auto plants)

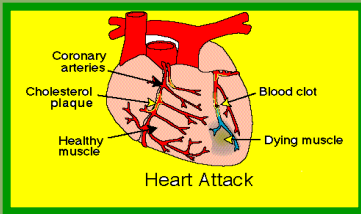
Hazards increased in cold
weather with closed doors and
windows



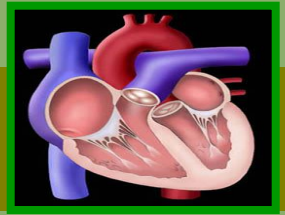
CAD - Carbon monoxide

Exposure: Forklift operators,
Foundry workers, Miners,
Mechanic, Firefighters.
Cigarette smoking





Phatogenesis



- Binds to hemoglobin more avidly than O_2 (CO has 200x oxygen's affinity)
(carboxy hemoglobin)
- Binds mitochondrial enzymes and myoglobin
- Increases platelet stickiness
- Decreases arrhythmia threshold





Pathogenesis & Clinical findings



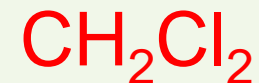
- Cardiac out put and coronary blood flow to meet the metabolic demand of heart.
(coronary artery disease,MI)
- Chronic exposure accelerate artherogenesis
- Acute:
 - Headache (early) ,nausea,dizziness,fatigue ,.....coma
- Chronic:
 - Aggravate angina pectoris,COPD ,
 - Cardiac arrhythmia,Cardiomyopathy.



Carbon monoxide



Methylene Chloride

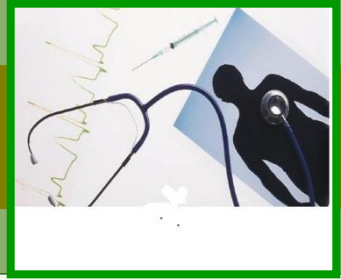


- Solvent: degreasing, paint stripping
- Absorption through **respiratory** route or through **skin**
- Metabolized in blood stream to CO
- Dihalomethane:
 - Dichloromethane, dibromomethane, diiodomethane

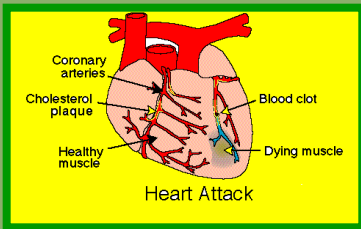




Examination



- ✓ **History:** CVS disease, anemia,...
- ✓ **Examination:** CVS, CNS, respiratory,...
- ✓ **Para-clinic:** EKG, CBC, thyroid function, carboxyhemoglobin level



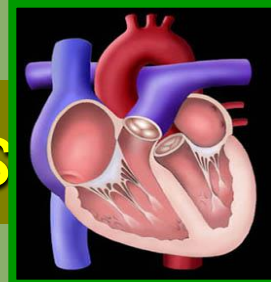
CAD : Organic Nitrates ***(nitroglycerin, ethylene glycol dinitrate)***

- Explosive manufacturing, construction work involving blasting, pharmaceutical manufacturing of nitrate
- CAD risk increased 2-3x after 20 years exposure: persists after removal
- **Three-fold increase** in acute deaths in younger men from ischemic CHD





Pathogenesis & Clinical findings



- Nitrate directly dilate blood vessels (coronary)
- Possible HTN after cessation of exposure Nitrate directly dilate blood vessels (coronary)
- **Withdrawal: HTN, angina, MI**
- Chest pain occurring during nitrate withdrawal

Prevention

- **Absorption:** the lung and skin
- Wear cotton gloves
- **Natural rubber gloves** should **not** be used
- The OSHA exposure limit 0.05 ppm
- PPE gear is recommended to avoid headache
- No readily available biochemical measure to detect excessive nitrate exposure
- Excessive exposure: Decreasing BP & Increasing HR

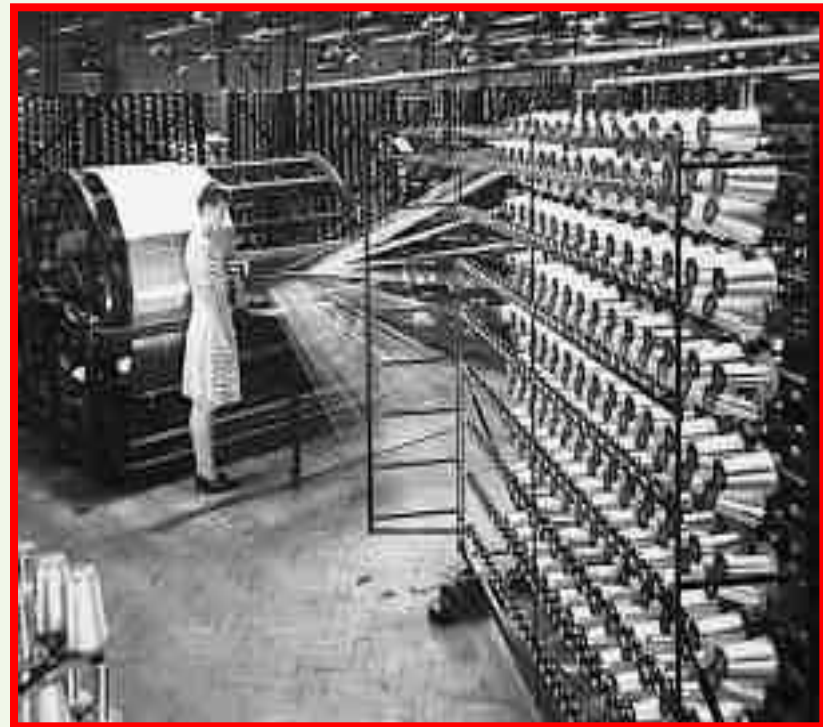


Coronary artery disease

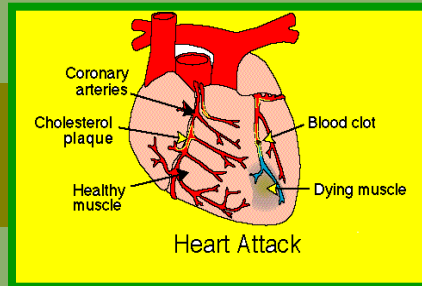


Carbon disulfide (CS₂)

- Solvent for rubber, oils
- Viscose rayon
- Pesticides
- Fumigant for grain, books
- Microelectronics industry (degreasing)
- Carbon tetrachloride & ammonium salt



Pathogenesis



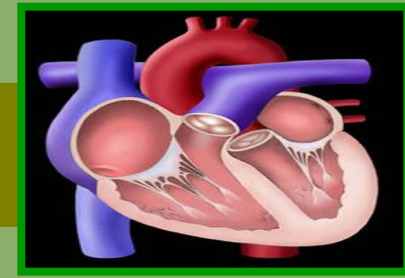
RR of 2 to 5x for death from CAD

- Epidemiologic evidence suggests a direct role in atherogenesis in blood vessels
- Disturbances of lipid metabolism and thyroid function (LDL[↑], hypothyroidism) (Risk factor atherosclerosis)
- May decrease fibrinolytic activity and enhance thrombosis

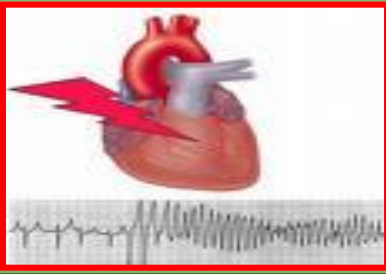




Clinical findings



- **Acute:** Fatigue, Headache,....., Polyneuropathy ,Encephalopathy
- **Chronic:** Hypertension, angina, MI (5-10years)
- **Early sign:** Abnormal ocular microcirculation , micro aneurysms, hemorrhages such **diabetic retinopathy**



Examination



✓ **History:** CVS & CNS disease, hypertension,...

✓ **Examination:**

✓ CVS, CNS, PNS,

✓ Ocular fundoscopy



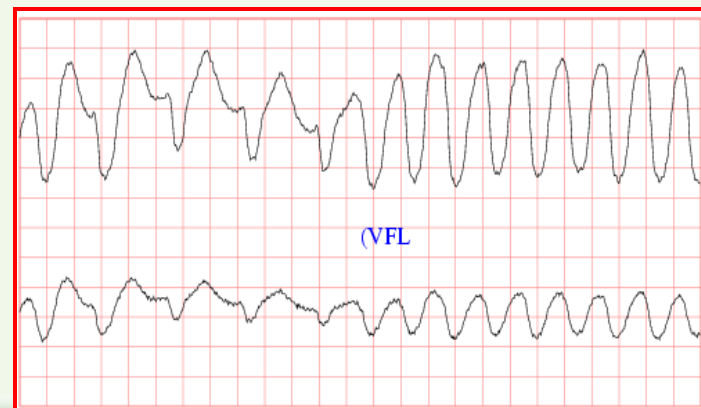
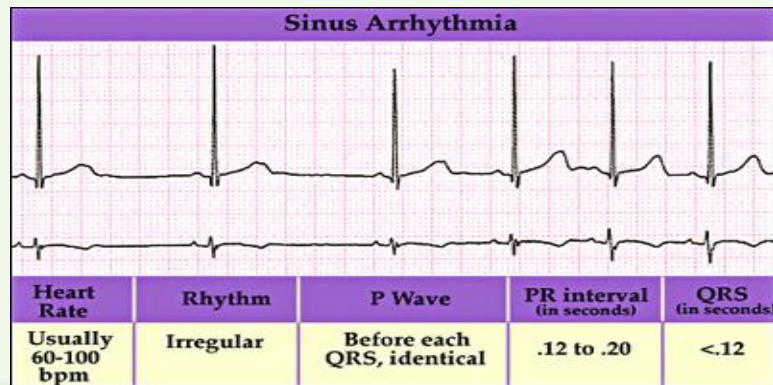


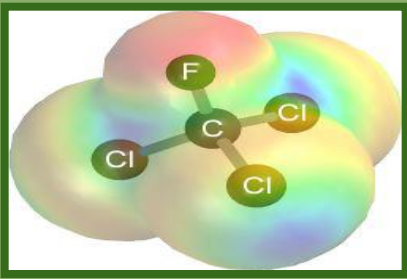
Examination



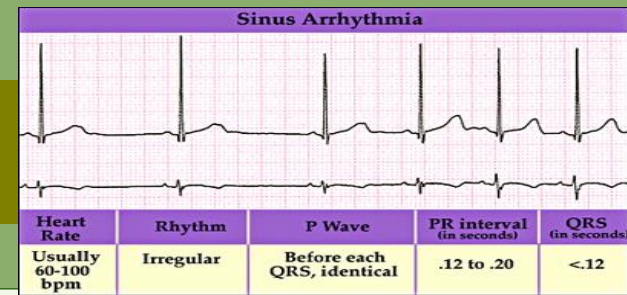
- ✓ **Para-clinic:**
 - ✓ EKG,
 - ✓ Thyroid function: Decrease in serum thyroxin levels
 - ✓ Lipid profile: Increase in serum cholesterol levels

Dysrhythmias

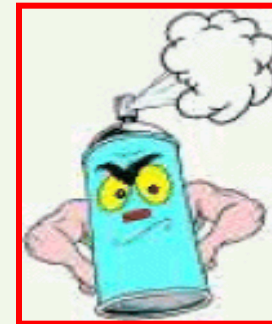




Dysrhythmias



- **Chlorofluorocarbons** (Freon® etc)
 - ◆ Refrigeration, air conditioning, propellants
 - ◆ Cleaning slide (surgical pathology laboratory)

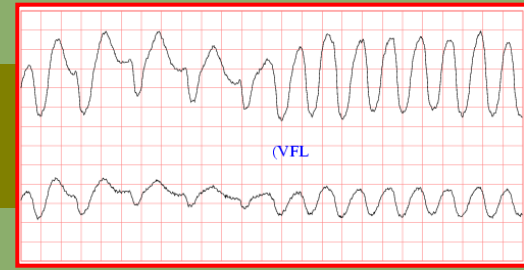


- Other solvents: Trichloroethylene, toluene

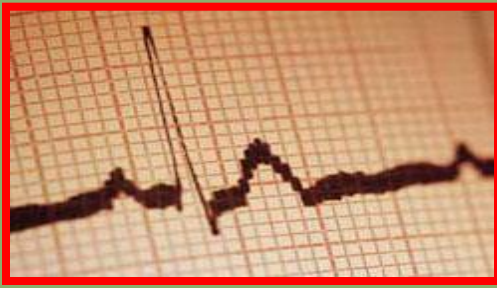




Pathogenesis & Clinical findings



- ◆ May sensitize myocardium to catechol effects
- **Low level** of exposure:
 - Sensitize, arrhythmia (VT,VF), death
- **Higher level:**
 - Depress sinus node activity, bradycardia, arrest
- **Symptom:**
 - Dizziness, headache, nausea, syncope
- **Sign:**
 - Ataxia, nystagmus, convulsion, coma, cardiac arrest



Examination



✓ History:

- ✓ CVS & CNS disease
- ✓ Dizziness, headache, nausea, syncope
- ✓ Alcohol or caffeine

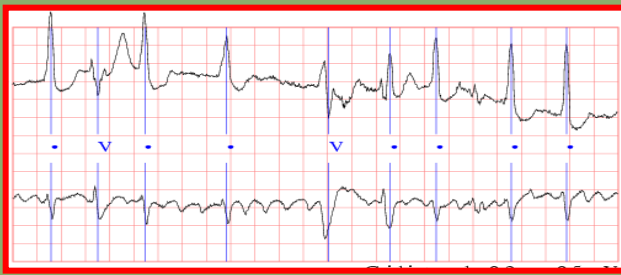
✓ Examination:

- CNS: ataxia, nystagmus, convulsion,
- CVS: HR & BP normal (arrhythmia)

✓ Para-clinic:

- ✓ ECG monitoring **at work**
(arrhythmia)

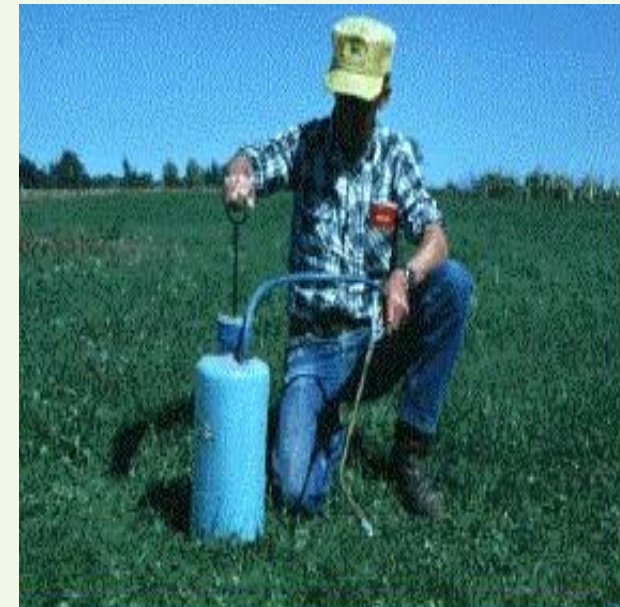




Dysrhythmias

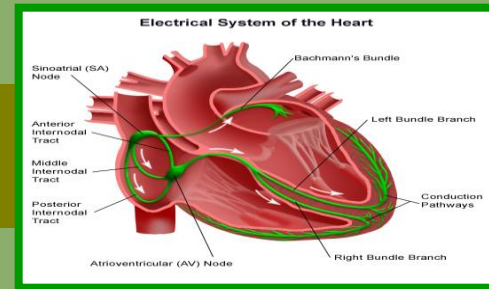


- Organophosphate & Carbamate Insecticides
 - ◆ Agriculture
- Inhibit acetylcholine esterase
 - ◆ **Early:** Tachycardia & mild hypertension (nicotinic receptors)
 - ◆ **Late:** Bradycardia & hypotension (muscarinic receptors)





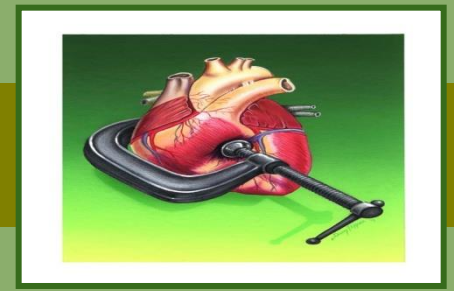
Clinical findings



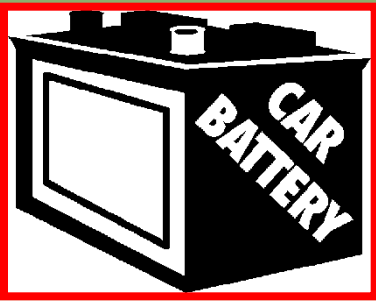
- Symptom:
 - Weakness, headache, sweating, nausea, diarrhea abdominal cramps, blurred vision
- Sign:
 - Small pupils, muscle fasciculation, salivation
 - ◆ **Early** (tachycardia & hypertension)
 - ◆ **Late** (bradycardia & hypotension)
- Antiarrhythmic drugs:
 - That depress conduction (**quinidine, procaineamide**) and **calcium channel blockers** should be avoided



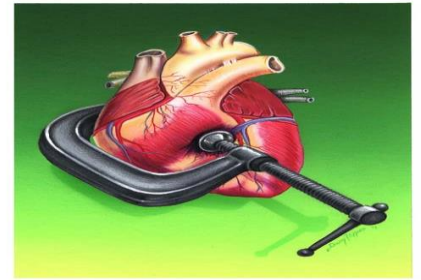
Cardiomyopathy



- **Solvent:** Dilated cardiomyopathy
- **Lead, arsenic**
- **Cobalt:** used to stabilize beer foam
- Cardiomyopathy reported in beer drinkers several months afterward



Hypertension



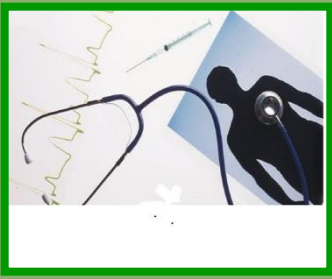
- **Lead:**

- Probable mechanism is via renal injury
- May also increase vascular tone and resistance



- **Cadmium:**

- Possibly associated with HTN; noted to occur at levels below nephrotoxic dose



Hypertension



Carbon disulfide

- Vascular nephropathy and accelerated atherogenesis appear to be mechanisms

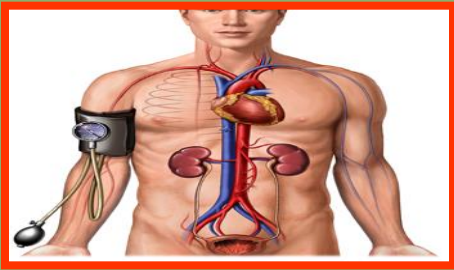
Noise, shift work

- Postulated effects mediated by stress response (increase sympathetic and hormonal mediator release)

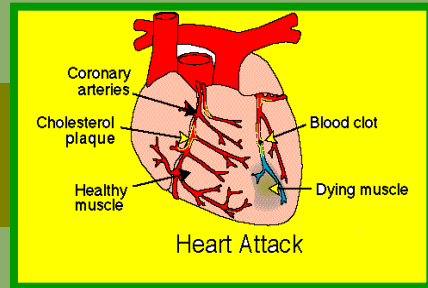
Peripheral arterial disease

- **Arsenic:**
 - **Blackfoot disease**
 - **Hypertension** (Drinking)
- **Vinyl chloride**
- **Vibration**





Physical agent



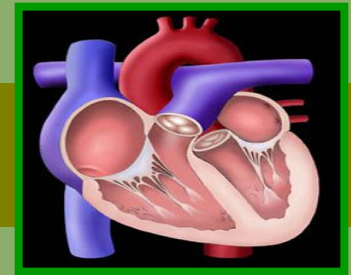
- **Heat & Cold :**
 - Angina, MI, sudden death
- **Noise:**
 - Increase epinephrine levels, vascular resistance, heart rate, blood pressure
- **Vibration:** Raynaud phenomenon



WORK



HEART

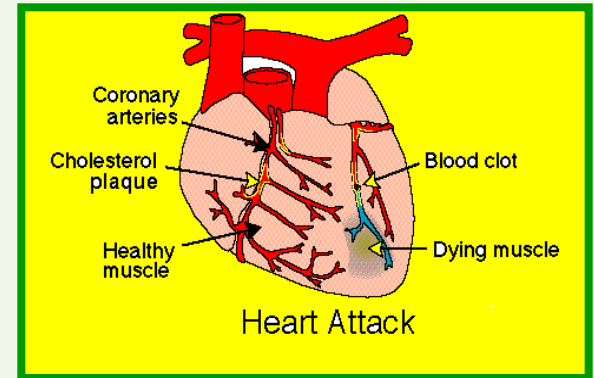


Workplace hazard

cause



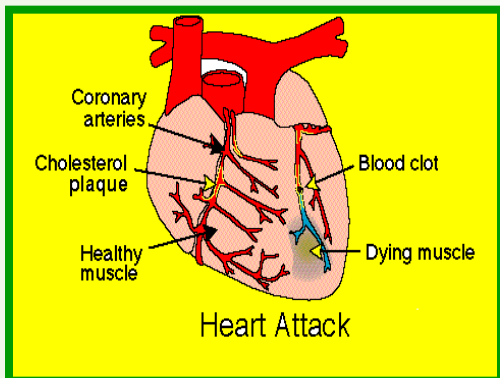
**Occupational
health**



affect



**General
health**



Cardiovascular effects on work

Some figures on heart disease in US:

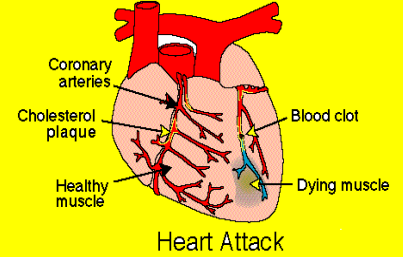
- 1.5 million MI each year
- Nearly 200,000 CABG per year
- Over 80% of workers are generally able to return to work after initial MI or CABG

Consider in the disabled individual:

- Inadequate treatment
- Depression
- Socio-economic explanations
- Whether accommodation or changing non-essential requirements of job will allow return.



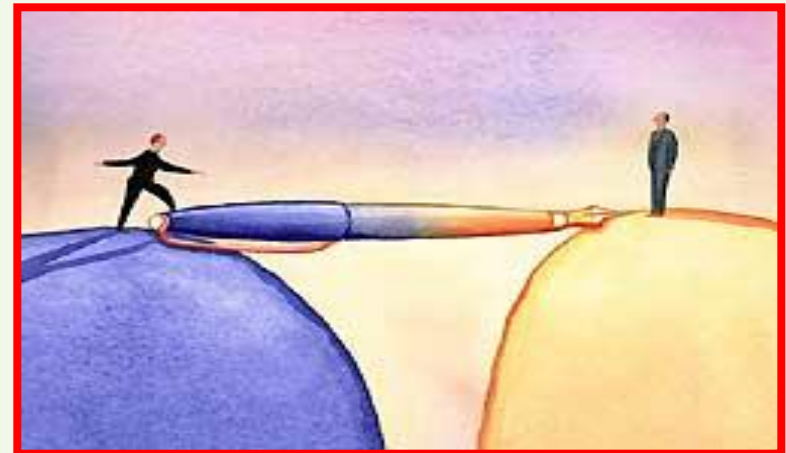
Cardiac Rehabilitation



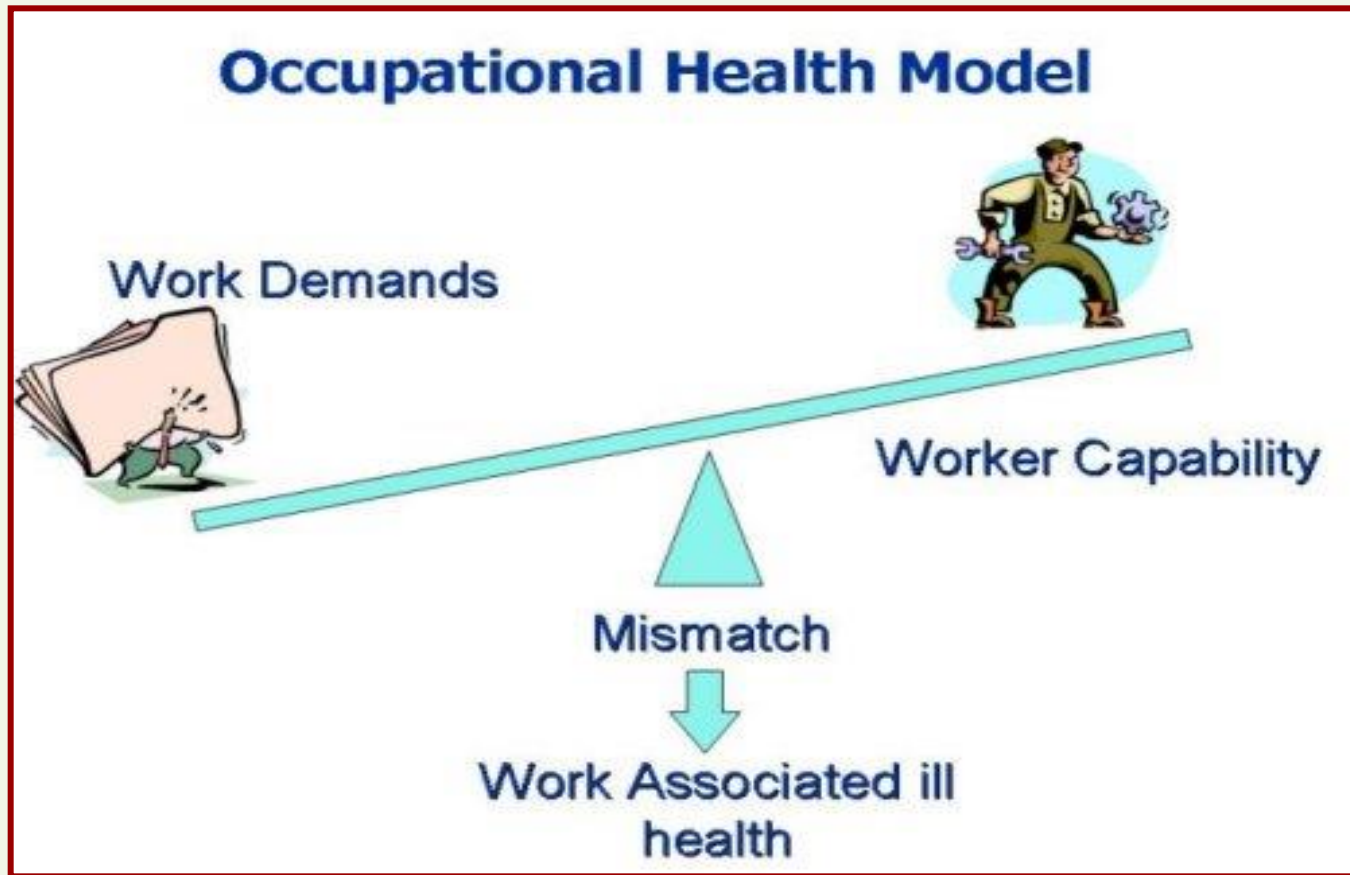
- **Program**
 - Aims
 - Initial
 - Team work
 - Education, exercise



- **Return to work:**
 - Ability
 - Aggravated
 - Safety (self or...)

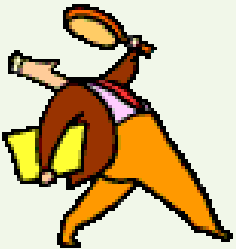
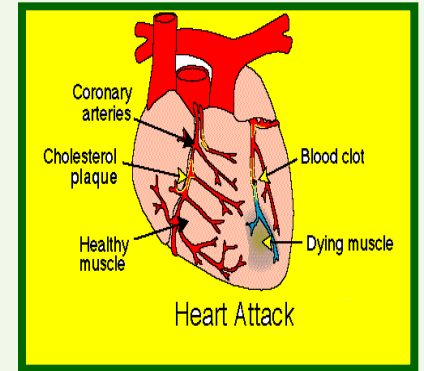
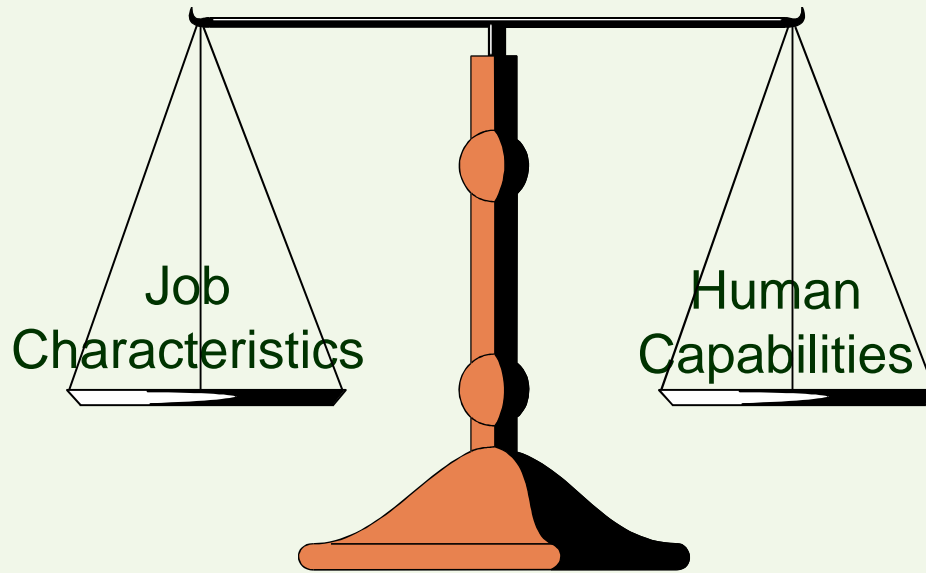
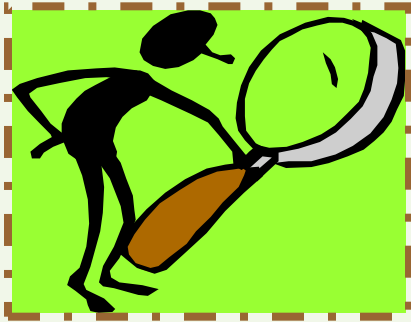
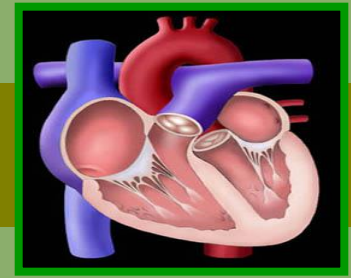


Examination : Return to work





Job & Ability



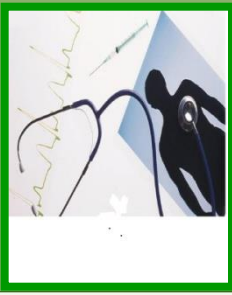
Fitness For Work



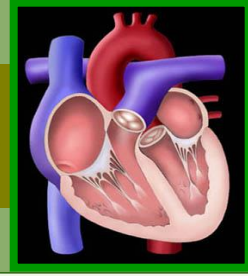


Fitness

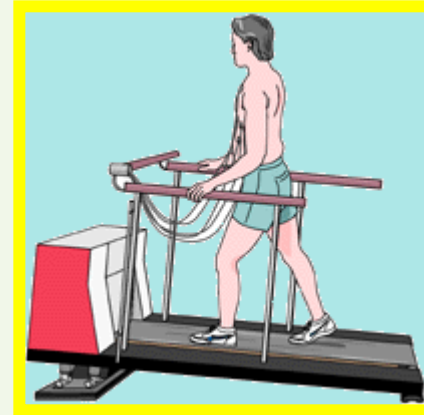
- ▶ Fitness and unfitness are complex entities based on the functional, anatomic, psychologic, educational and social characteristics of the worker.
- ▶ **Fitness** : The ability to **carry out daily tasks** with alertness and vigour, without undue fatigue, and with enough reserve to meet emergencies or to enjoy leisure time pursuits.



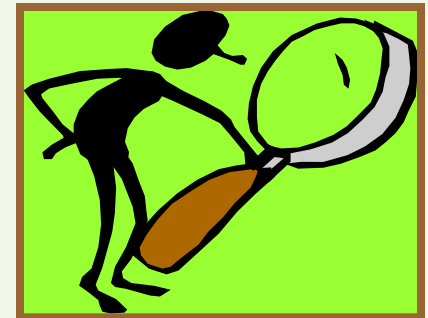
Fitness-for-Duty Evaluations



- Job & Ability
- Sign, Symptom
- Echo, ETT

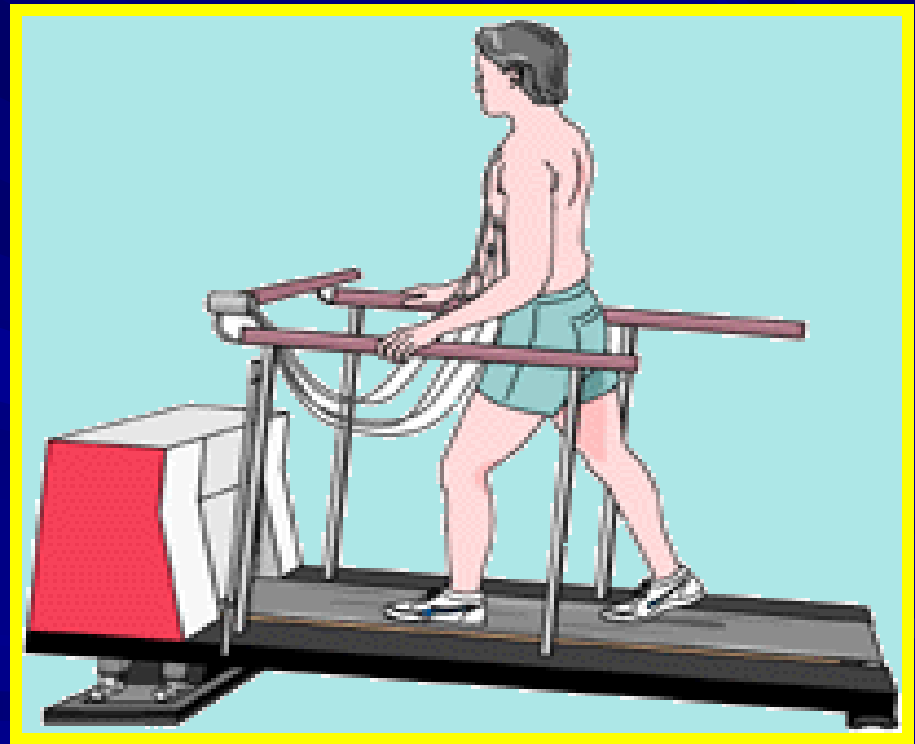


- Task (dynamic, lifting, pull...)
- Environmental (heat, cold....)



Sub-maximal exercise test

■ Methods of Bruce

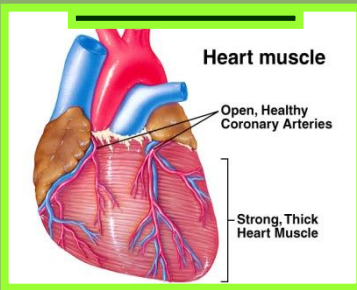


Max MET Values - Men

Age	Poor	Fair	Average	Good	Excellent
< 29	≤6.9	7.1-9.7	9.7-12.5	12.6-15.1	≥ 15.1
30-39	≤ 6.5	7.1-8.8	8.9-12.0	12.1-14.3	≥ 14.3
40-49	≤ 5.7	5.7-7.7	7.7-10.8	11.1-12.8	≥ 12.8
50-59	≤ 5.1	5.1-7.1	7.1-10.8	10.9-12.3	≥ 12.3
60-69	≤ 4.5	4.6-6.5	6.6-10.3	10.3-11.7	≥ 11.7

McArdle, Katch, & Katch (2001)

By: Dr.Attaroni



Assessing work capacity



- 3.5 METs : Bartending, frequent walking with 10lb objects (many office jobs)
- 4 - 5 METs : Painting, masonry work, light carpentry
- 5 - 6 METs : Lighter digging, shoveling
- 6 - 7 METs : Heavier or more frequent shoveling
- 7 - 8 METs : Carrying 50-60 lbs; sawing hardwood

Physical demand characteristics of work (1993 Leonard Matheson & Ministry of Labor)

Physical Demand Level	Occasional 0-33% work day	Frequent 34-66% of workday	Constant 67-100% of workday	Typical Energy Required
Sedentary	10 lbs	Negligible	Negligible	1.5 -2.1 METS
Light	20 lbs	10 lbs	Negligible	2.2 – 3.5 METS
Medium	20-50 lbs	10-25 lbs	10 lbs	3.6 – 6.3 METS
Heavy	50-100 lbs	25-50 lbs	10-20 lbs	6.4 – 7.5 METS
Very Heavy	Over 100 lbs	Over 50 lbs	Over 20 lbs	Over 7.5 METS

McArdle's Bench Step Test



Use the subject's weight in kilograms (1 lb = 0.45 kg) and maximum heart rate after exercise to estimate VO_2max from Figure 1. Draw a line from the pulse rate immediately after exercising to the subject's weight, and read the VO_2max where your line intersects the VO_2max line. Be sure to use the scales appropriate to the sex of the subject.

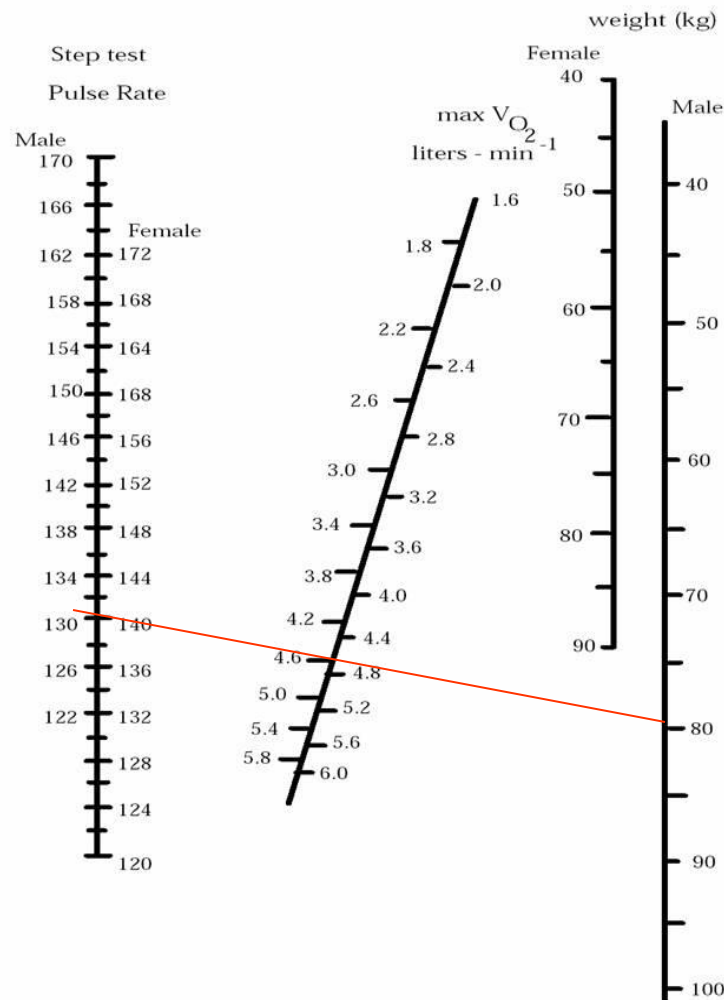
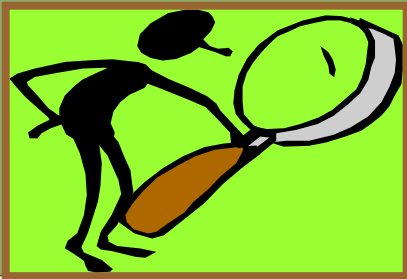


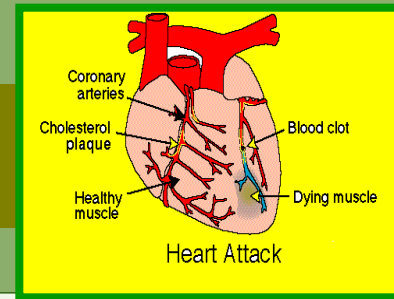
Figure 1. Nomogram for determining VO_2max from maximum pulse rate after step test and weight.

Return to work

- Eight-hour workday with typical breaks (40% of maximal MET level)
- Once or twice a day with 15 min intervals (80% of maximal MET level)



Cardiac Activity Work Sheet



✓ Environment :

Heat/cold , Humidity ,Safety of others, Toxin,
Remoteness medical care

✓ Task :

Isometric , Competitive , Rest/work periods , Energy requirements
Duration of task

✓ Individual:

Myocardial Function [ECHO] , Myocardial Jeopardy ,
Myocardial Ischemia ,Ability to Pace , Obesity , Physical condition ,
Skill Level , Function Capacity [ETT]

✓ Risk: Low,Moderate ,High

Cardiac Activity Work Sheet

Risk Environment	Low	Moderate	High
Heat/cold	ambient temp	30-50 deg F	<30deg F
Safety of others	No risk	75-85 deg F possible risk	>85 deg high risk
Humidity	low	variable	high
Remoteness	help available	>2 hours for medical care	No medical help available
Task			
Isometric	low	<20% max force	>20%max force
Competitive	low	some competition	highly Competitive
Reset/work periods	yes	some	not at al
Energy requirements (% maximal capacity)	<50%	50-80%	>80%
Duration of task	<30 sec	<2 min	>2 min
Individual			
Myocardial function	normal	moderate impairment	marked impairment
Myocardial jeopardy	none	moderate	severe
Myocardial ischemia	none	moderate	severe
Ability to pace	able	variable	unable to pace
Obesity	normal weight	BMI= 27-30	BMI>30
Physical condition	exercising regularly	moderate	sedentary
Skill level (for task)	high	medium	low
Function capacity (from stress test)	> 7 METs	4-7 METs	<4METs

Cardiac Activity Work Sheet

Name- ED JONES

Task - CHOPPING WOOD

Risk

<u>Environment</u>	Low	Moderate	High
Heat/cold	ambient temp	30-50 deg F 75-85 deg F	✓ < 30 deg F > 85 deg F
Safety of others	no risk	✓ possible risk	high risk
Humidity	low	✓ variable	high
Remoteness	help available	✓ 2 hours for medical care	no medical help available
<u>Task</u>			
Isometric	low	✓ < 20% max force	> 20% max force
Competitive	✓ low	some competition	highly competitive
Rest/work periods	yes	✓ some	not at all
Energy requirements (% maximal capacity)	< 50%	50-80%	✓ > 80%
Duration of task	< 30 sec	< 2 min	✓ > 2 min

Individual

Myocardial function	normal	✓ moderate impairment	marked impairment
Myocardial jeopardy	✓ none	moderate	severe
Myocardial ischemia	none	✓ moderate	severe
Ability to pace	✓ able	variable	unable to pace
Obesity	normal weight	✓ BMI 27-30	BMI > 30
Physical condition	exercising regularly	✓ moderate	sedentary
Skill level (for task)	high	medium	low
Functional capacity (from stress test)	> 7 METs	✓ 4 - 7 METs	< 4 METs

Recommended ☐

Not Recommended ☒

Reviewed by: Wm Daffoe, MD

Figure 7.2. Example of the use of the Cardiac Activity Work Sheet. This activity was deemed inadvisable because of ischemia at 7 METs and the remote location of the activity. Knowledge of the myocardial jeopardy was

incomplete because an angiogram has not yet been performed. With an appropriate work/rest cycle, the physical demands possibly could be met.

Myocardial Function



- نارسایی قلبی و شدت آن
- مصرف دیژیتال و دیورتیک
- کاردیومگالی
- گالوپ S3
- سابقه انفارکتوس قلبی
- میزان کاهش فشارخون سیستولیک در تست ورزش
- Ejection Fraction (رکن اساسی)

Myocardial Jeopardy



- میزان آسیب و شدت تخریب میوکارد
- تکرار و تعداد و شدت آنژین ها
- افت قطعه S-T بیش از 2 میلی متر در تست ورزش
- اختلال در تست تالیوم اسکن
- میزان کاهش فشارخون سیستولیک در تست ورزش
- نتیجه آنژیوگرافی (رکن اساسی)

Myocardial Ischemia

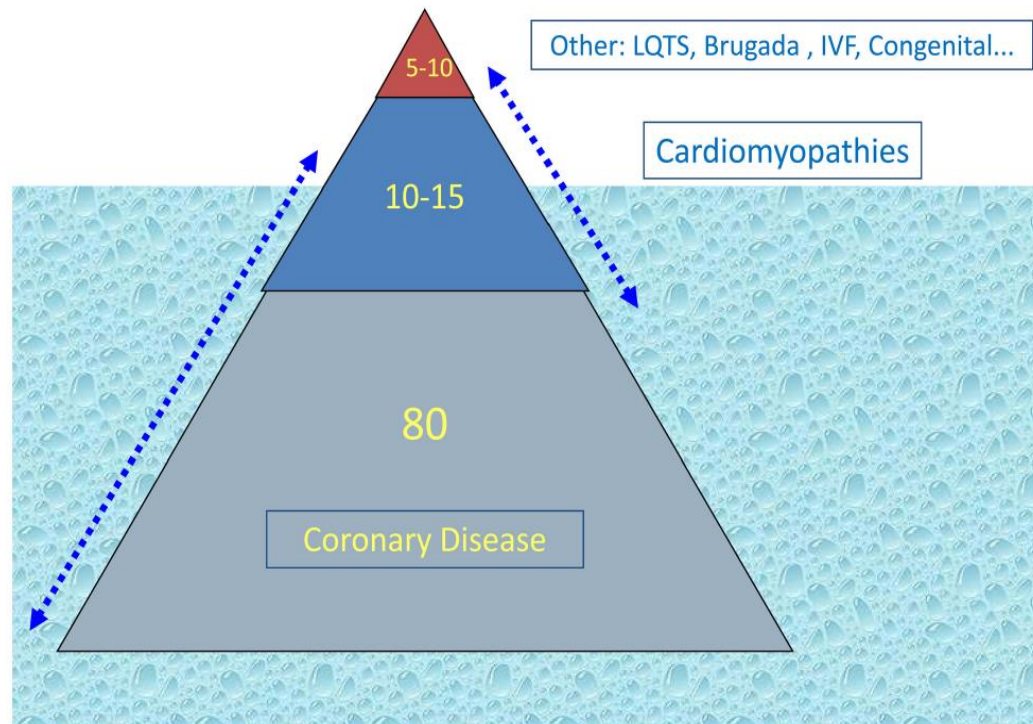


- آنژین در زمان استراحت یا شبانه یا ناپایدار
- آنژین پیش رونده
- اختلال در پاسخ به نیتروگلیسرین
- افت قطعه S-T در حالت استراحت در نوار قلب

Return to work

- Risk (Work restriction)
- Capacity (Work limitation)
- Tolerance

Etiologies of Sudden Cardiac Death



Prognostic Scores in Stable CAD

DUKE SCORE

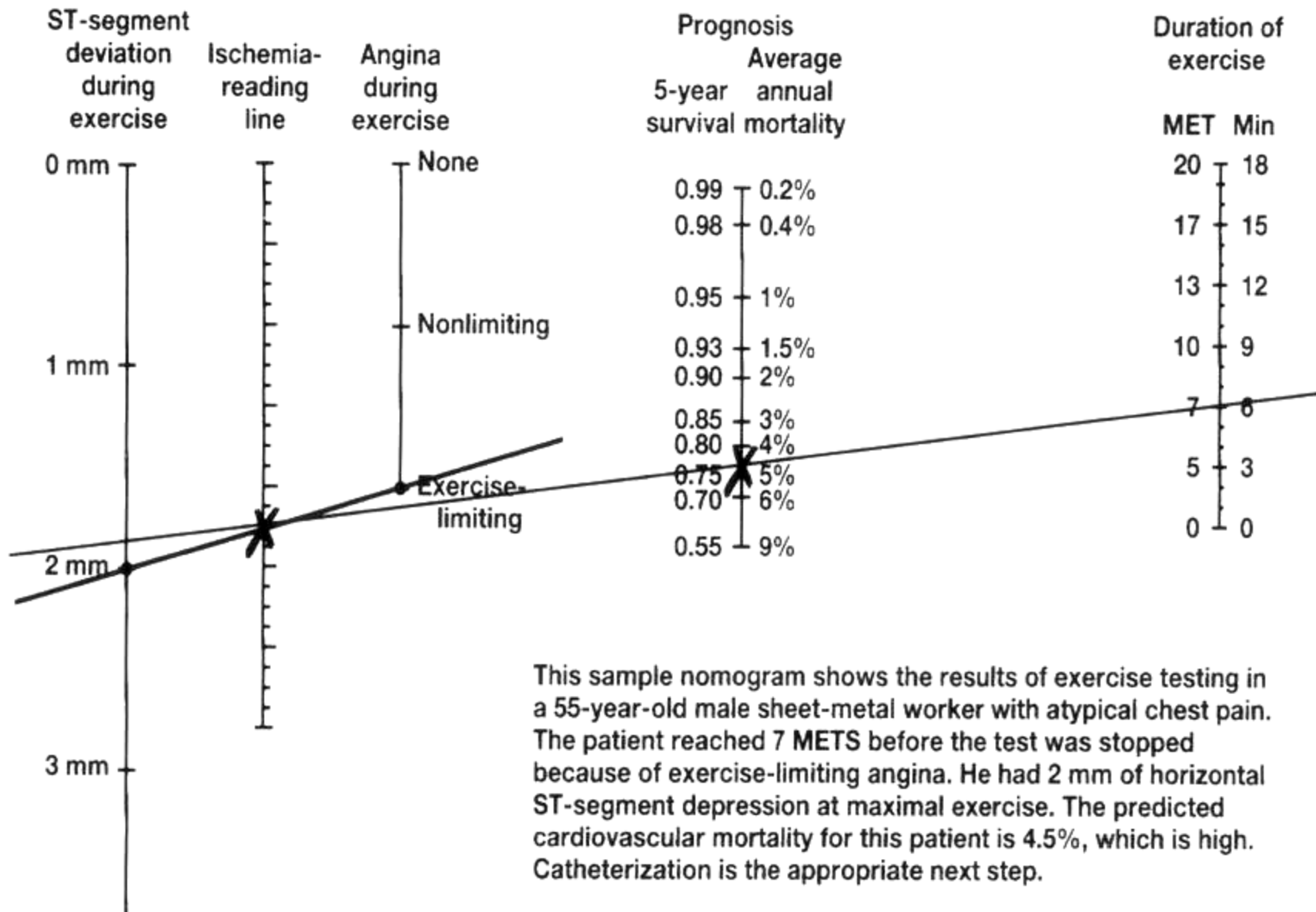
METs - 5 X [mm E-I ST Depression] -
4 X [Treadmill Angina Index]

******see Nomogram******

METHODS: Duke Treadmill Score

- The equation for calculating the Duke treadmill score (**DTS**):

DTS = Exercise time - (5 × ST deviation) - (4 × exercise angina), with 0 = None, 1 = Non-limiting, and 2 = Exercise-limiting.



METHODS: Duke Treadmill Score

- The score typically ranges from - 25 to +15.
- These values correspond to *low-risk (with a score of $\geq +5$)*, *moderate-risk (with scores ranging from -10 to +4)*, and *high-risk (with a score of ≤ -11)* categories.

فیبریلاسیون دهلیزی

* خطر ناتوانی ناگهانی بعلت آمبولی

* میزان رخداد استروک سالیانه وابسته به سن و تعداد عوامل خطر و آنتی کواگوان
ترایی می باشد.

* فیبریلاسیون دهلیزی بدون ریسک فاکتور و بدون اختلال ساختاری قلبی و سن کمتر
از 65 سال:

* ریسک آمبولی سالیانه حدود 1% و

* وارفارین ترایی این ریسک را تا 70% کاهش می دهد.

عوامل خطر

* سابقه TIA و استروک

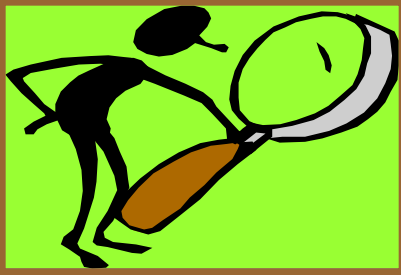
* دیابت ، هایپرتنشن و تیروئیدکوزیز

* سن

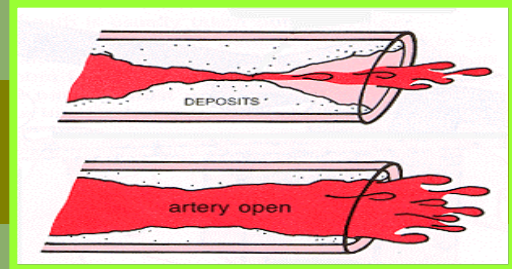
- * LV dysfunction
- * Increased LA size
- * Prosthetic Valve
- * Increased wall thickness
- * Mitral annular calcification

ریسک سالیانه استروک

- * سن کمتر از 65 سال بدون ریسک فاکتور : 1%
- * سن کمتر از 65 سال با یک یا بیشتر از ریسک فاکتور : 4.9%
- * سن بین 65-75 سال با یک یا بیشتر از ریسک فاکتور : 5%
- * سن بیش از 75 سال بدون ریسک فاکتور : 3.5%
- * سن بیش از 75 سال با یک یا بیشتر از ریسک فاکتور : 8.1%

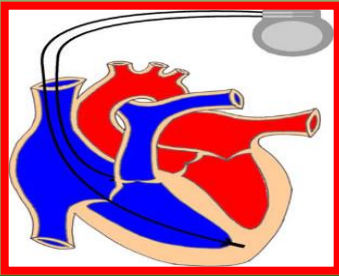


Fitness-for-work



- Many safety-sensitive jobs (fire, police) have qualification requirements based on exercise testing or physical fitness standards

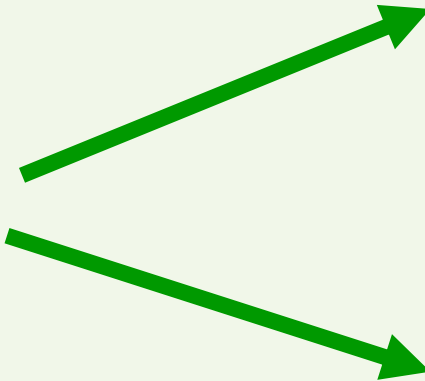
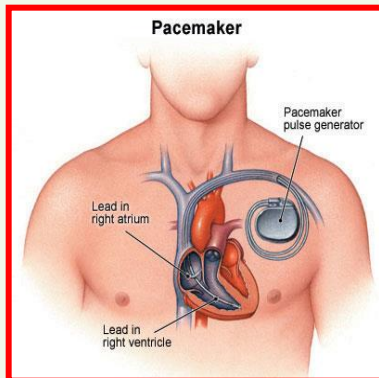




Fitness-for-work



- **Pace maker:** Electromagnetic field



Questions?



