



IN THE NAME OF GOD

# Occupational Cancers



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# Neoplasm

- Neoplasia : new growth
- An abnormal mass of tissue the growth of which exceeds and is uncoordinated with that of normal tissues and persist in the same excessive manner after the cessation of the stimuli which evoked the change.  
(Willis, 1952)

# What is occupational cancer?

**Occupational cancer is cancer that is caused wholly or partly by exposure to a carcinogen at work.**

# What is a carcinogen?

**\*A carcinogen is a substance, mixture or agent that can cause cancer or it increases the risk of developing cancer.**

**\*Known carcinogens include viruses (e.g., Hepatitis B), hormones (e.g., estrogens), chemicals (e.g., benzene), naturally occurring minerals (e.g., asbestos), alcohol, and solar radiation (e.g., ultraviolet radiation).**

# How common is occupational cancer?

Research shows that the amount of cancer related to occupational exposure varies with the type of cancer.

**The most common types of occupational cancer are lung cancer, bladder cancer and mesothelioma.**

Type of Cancer	Related to Occupational Exposure Estimated % (USA)
Lung	6.3-13%
Bladder	3-19%
Mesothelioma	?
Leukemia	0.8-2.8%
Laryngeal	1-20% (men)
Skin Cancer (non-melanoma)	1.5-6% (men)
Sinonasal and nasopharyngeal	31-43% (men)
Kidney	0-2.3%
Liver	0.4-1.1 (vinyl chloride only; men)

# Scientists identify cancer-causing agents using information from:

- \*Studies that look at the relationship between an exposure and the risk of developing cancer in human populations
- \*Experiments that examine the relationship between an exposure and the risk of developing cancer in laboratory animals
- \*Tests that examine the ability of an agent to cause mutations (genetic changes) in cells, and
- \*Knowledge of chemical structures and the way in which chemicals interact with the body

# Are there lists of substances or agents that can cause occupational cancer?

\*Identifying carcinogens is complicated. Fortunately, there are several organizations that evaluate the available information according to specific criteria.

\*The most authoritative lists of carcinogens are published by the:

\*International Agency for Research on Cancer (IARC), an agency of the World Health Organization

\*American Conference of Governmental Industrial Hygienists (ACGIH), an independent US organization

\*US National Toxicology Program (NTP), a US interagency program

# **IARC(International Agency for Research on Cancer)**

**\*\*IARC classifies each agent or exposure into one of five groups according to the strength of scientific evidence for carcinogenicity, as follows:**

**\*\*Group 1 - Carcinogenic to humans**

**\*\*Group 2A - Probably carcinogenic to humans**

**\*\*Group 2B - Possibly carcinogenic to humans**

**\*\*Group 3 - Not classifiable as to its carcinogenicity to humans**

**\*\*Group 4 - Probably not carcinogenic to humans**

# American Conference of Governmental Industrial Hygienists (ACGIH)

- \*ACGIH assigns chemicals or agents to one of the following 5 categories:**
- \*A1 - Confirmed human carcinogen**
- \*A2 - Suspected human carcinogen**
- \*A3 - Confirmed animal carcinogen with unknown relevance to humans**
- \*A4 - Not classifiable as a human carcinogen**
- \*A5 - Not suspected as a human carcinogen**

# US National Toxicology Program (NTP)

**\*Every two years, NTP publishes a list of agents that they have evaluated and assigned to one of two categories:**

**\*Known to be Human Carcinogens**

**\*Reasonably Anticipated to be Human Carcinogens**

# Etiology of cancer

- Personal characteristics such as age, sex, and race
- Family history of cancer
- Diet and personal habits such as cigarette smoking, alcohol consumption
- The presence of certain medical conditions
- Damage in different genes
- Exposure to cancer-causing agents in the environment (workplace)
- Cancer is [Gene<sup>n</sup> - environment<sup>n</sup>] interactions

# Cancer Clusters

Cancers clusters: an unusual concentration of cancer cases in a defined area or time , among workers of a different age or sex group

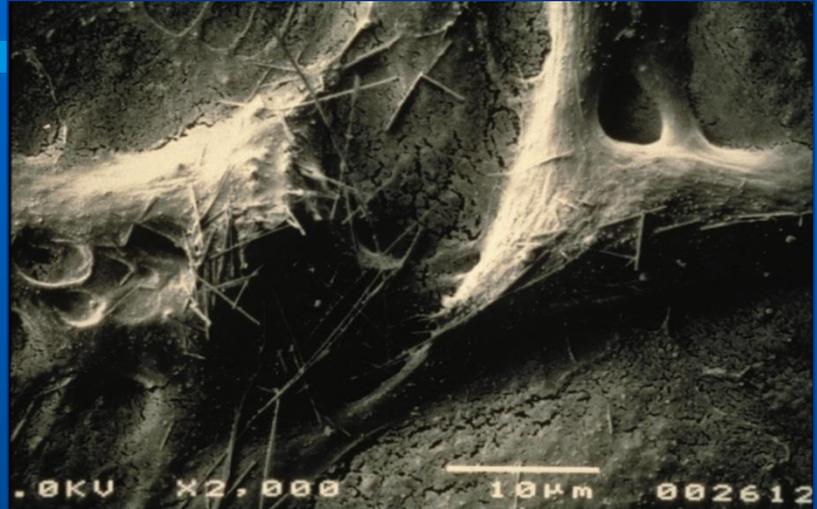


Asbestos, lung cancer and mesothelioma, at a pipe insulation manufacturing plant 1970's .

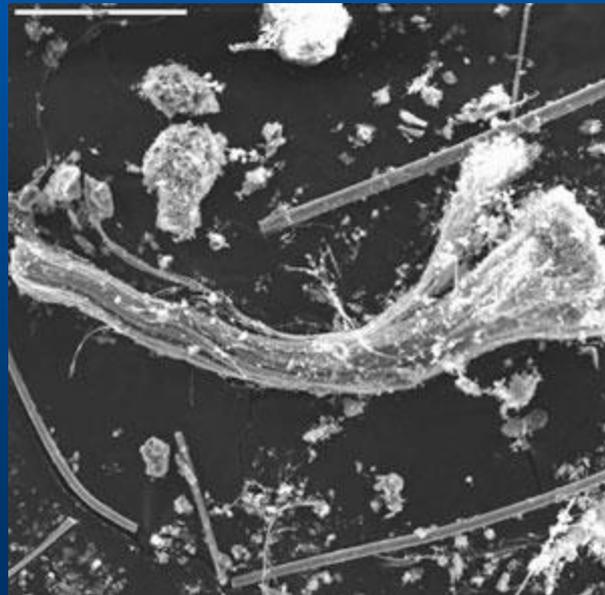


Vinyl chloride, angiosarcoma of the liver hydraulic cleaner from an open vinyl chloride reactor, 1974

# Asbestos: Types



<b>Serpentine</b> (93% of commercial use)	<b>Amphibole</b> (7% of commercial use)
<b>Chrysotile</b>	<b>Actinolite, Amosite, Anthophyllite, Crocidolite, Richterite, Tremolite</b>



# What is Asbestos?



**Because asbestos fibers are so small, once released into the air, they may stay suspended there for hours or even days.**

## Blue asbestos



## White asbestos



## Brown asbestos



# Exposure setting

- **Industries :**

**mining, friction product , asbestos cement , textile , shipyard , construction , insulator ( roofing , flooring , heat insulation), plumbers & pipefitters , steamfitter, transport , ...**

**brake , roofing , flooring , heat & acoustic insulation**



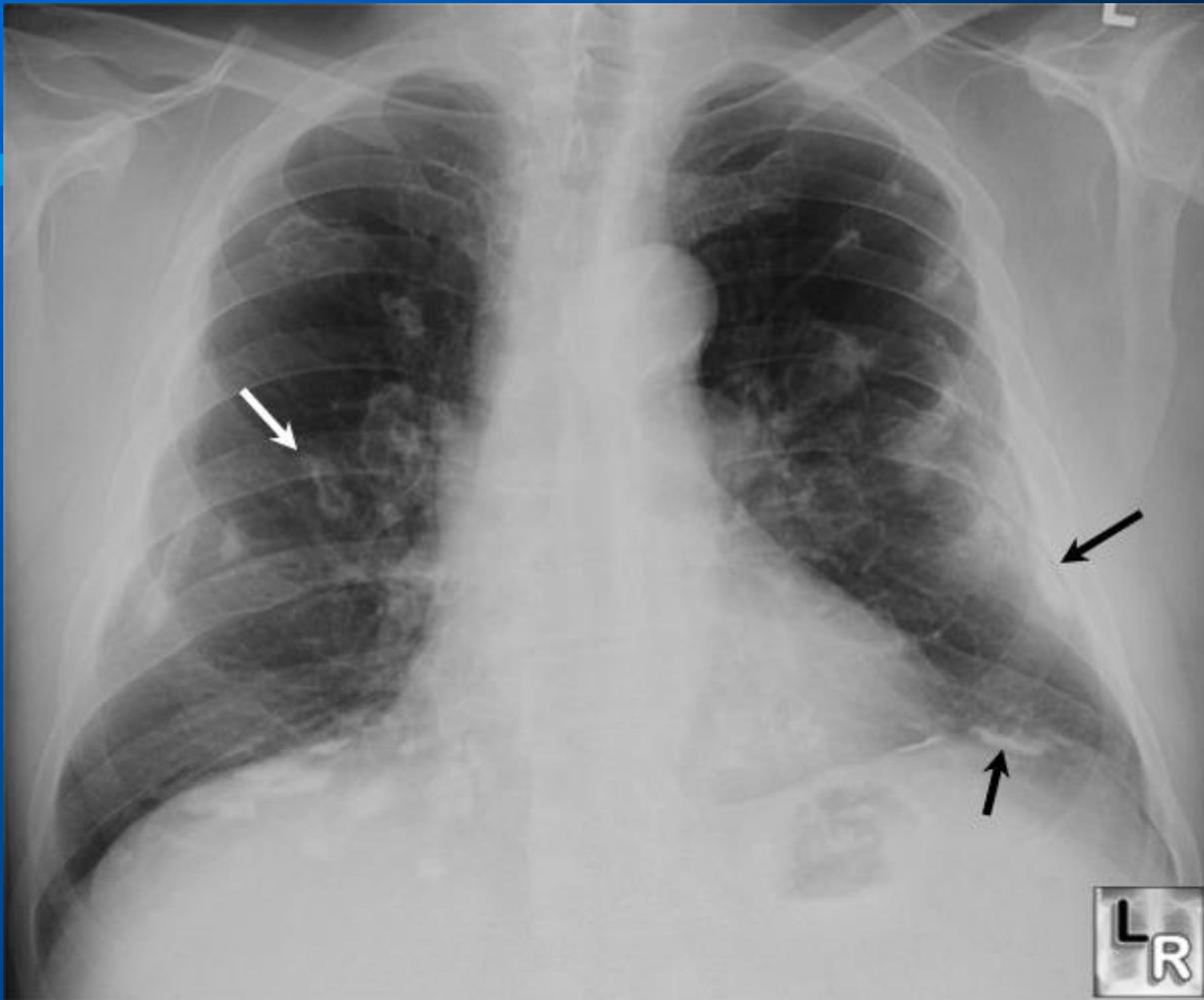
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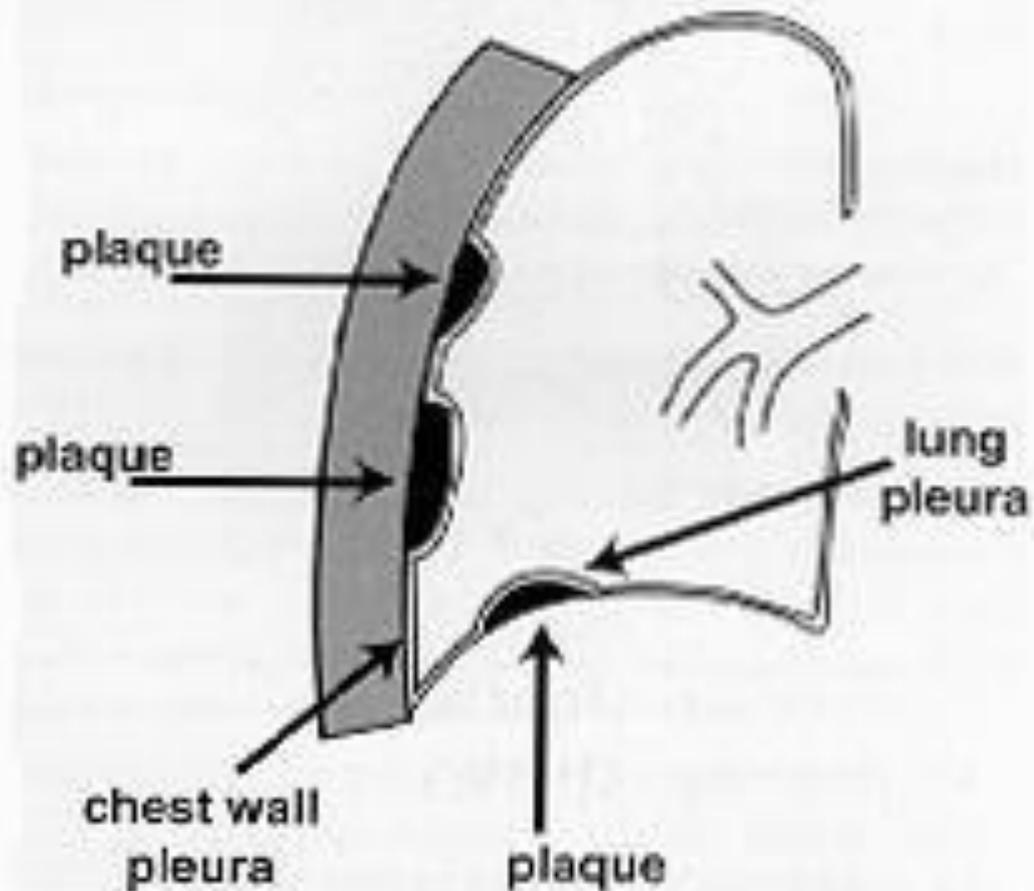


# Epidemiology

- **Linear dose-response relationship**
- **Some exposure threshold (malignancy and plural diseases have not)**
- **Mortality : 38 % lung cancer**
  - 20 % asbestosis**
  - 8 % mesothelioma**
- **Occupational exposure standard: 0.1 fiber/ml (2/1000, 5/1000)**



# Pleural plaques



# Asbestosis

- May or may not accompanied with pleural disease
- Additive or synergistic effect of smoking and welding
- Worsen even after exposure ceases
- Increase risk for lung cancer , mesothelioma , laryngeal cancer

# Asbestos Diseases

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**Asbestosis**

**Pleural Plaques**

**Lung Cancer**

**Mesothelioma**

**G-I Tract**

# Lung cancer

- \*Most common problem with asbestos
- \*Heavily exposed workers have 5-7 times increased risk over lifetime
- \*About same level of risk as a pack a day cigarette smoking
- \*Interacts with cigarettes: 50-90 times increased risk for both combined
- \*Quitting smoking reduces risk

# Other Cancers

## **\*\*Mesothelioma**

**Cancer of lining of the lungs –**

**Only caused by asbestos –**

**Smoking not a risk factor –**

## **\*\*G-I tract cancer**

**2-3 times increased risk for heavily –  
exposed**

# Asbestos

- classified Commercially
  - white asbestos (chrysotile)
  - brown asbestos (amosite)
  - blue asbestos (crocidolite)
- 90 %< of industrial use is :chrysotile
- All types can lead to all disorders
- Pulmonary & non-pulmonary
- Malignant & non-malignant

# NIOSH CARCINOGEN LIST

## Potential occupational carcinogen:

1. Aniline and homologs, Asbestos
2. Chromates, Cadmium dust and fume, Coal tar pitch volatiles; coal tar products, Coke oven emissions
3. Arsenic and inorganic arsenic compounds, beryllium and beryllium compounds, cadmium compounds, nickel compounds, and crystalline forms of silica.
4. Diesel exhaust, DDT, Dimethyl Sulfate  
Dinitrotoluene, Dioxane
5. Environmental Tobacco Smoke (ETS) or passive smoking, Gasoline, Uranium, insoluble compounds  
Uranium, soluble compounds, PVC
6. Wood dust, Zinc chromate; class, chromium hexavalent

# Classification of Carcinogens:

1. سرطان زا در انسان: ازبست ، الكل،بنزن ، رادون ، تابش خورشید ، سیگار، اشعه ایکس و گاما
2. مشکوک به سرطانزائی در انسان ( **Probably or Possibly** ) : کروئوزت ، دود موتورهای دیزلی، فرمالدئید بی فنیل های پلی کلرینه **PCBS**
3. سرطانزائی با احتمال ضعیف در انسانها : میدان های **ELF**، استیرن ، قهوه

# Chemical Carcinogenesis in humans

Target organs	Agents	Industry	Tumour type
Lung	<b>Asbestos, Arsenic, Mustard gas, nickel, PAH (poly aromatic hydrocarbons), Tobacco smoke</b>	<b>Shipyard &amp; Insulation workers, Smelting of copper, zinc, lead, Mustard gas production w. Nickel mining, refining, plating; Coke oven workers, Aluminum reduction workers, Environment with active smoker</b>	<b>Squamous, large cell and small cc, adenocarcinoma</b>
Pleura	<b>Asbestos</b>		<b>Mesothelioma</b>
Oral cavity	<b>Tobacco smoke, alcohol beverage, Nickel</b>	<b>Boot &amp; shoe productions. Furniture manufacture, Alcohol productions</b>	<b>Squamous cell carcinoma</b>
GI	<b>Smoked, salted, pickled food, Tobacco, alcohol</b>	<b>Rubber Industry</b>	<b>adenocarcinoma Squamous CC</b>
Liver	<b>Aflatoxin, vinyl chloride, tobacco, alcohol, thorium dioxide</b>		<b>Hepatocellular C, Hemangiosarcoma</b>

# Chemical Carcinogenesis in humans

Kidney	Tobacco Smoke, phenacetin		Renal cell Carcinoma
Bladder	Tobacco, phenacetin benzidine	Magneta manufacture, auramine manufacture	Transitional cell carcinoma
Prostate	Cadmium		Adenocarcinom
Skin	Arsenic, benzopyrene, coal, mineral oil, cyclosporin A,PUVA	Coal gasification coke production.	SCC,BCC
Bone marrow	Benzene, tobacco, Ethylene oxide, Anti-neoplastic agents cyclosporin A	Rubber workers	Leukemia, Lymphoma

# Classification of occupational cancers

## The most common occupational cancers:

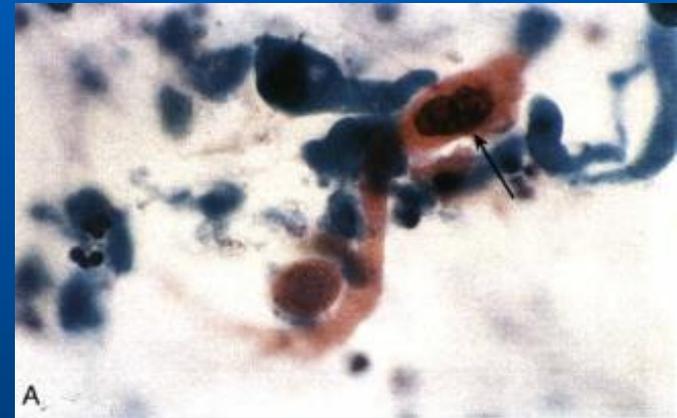
1. Lung Cancer & mesothelioma
2. Skin Cancer
3. Bladder Cancer
4. Leukemia

# Clinical evaluation

## Symptoms:

- 1. Central growth: cough, hemoptysis, wheeze and stridor, dyspnea from obstruction, pneumonitis**
- 2. Peripheral growth: pain (pleural involvement), cough, dyspnea, lung abscess syndrome**

# Lung Carcinoma



# Environmental tobacco smoke (ETS)

- ETS as a significant lung cancer risk factor accounts for 3000 lung cancer deaths/year in non-smokers (US)
- Tobacco smoking contains 500 chemicals , more than 20 are carcinogens
- Specific chemicals in tobacco is PAH, N-nitrosamine, aromatic amines, ethylene oxide
- Recent cigarette has less tar (PAH) and nicotine, tobacco –specific nitrosamine
- Lower nicotine cigarettes → more smoke (↑nicotine –addiction)

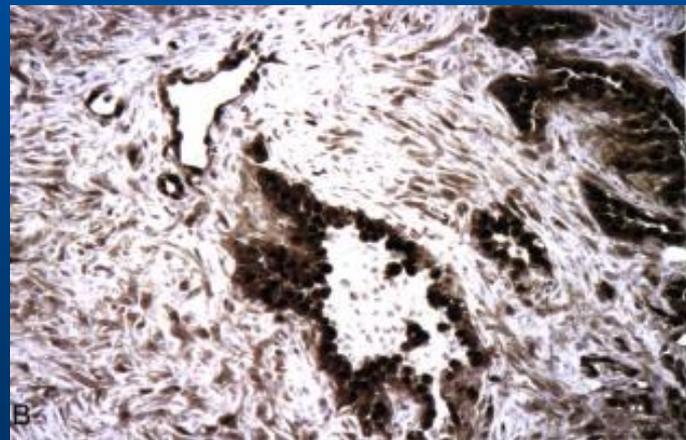
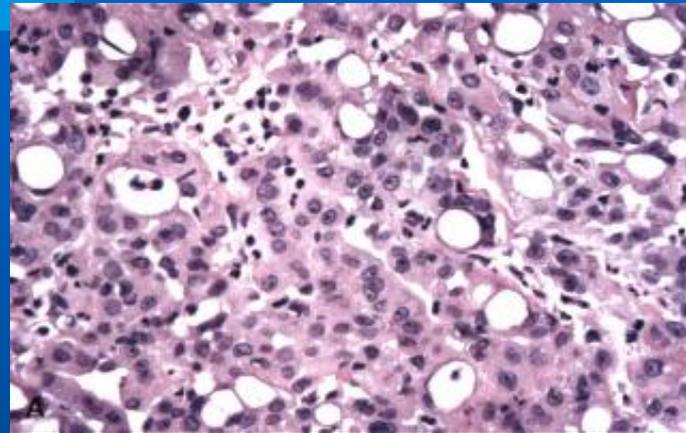
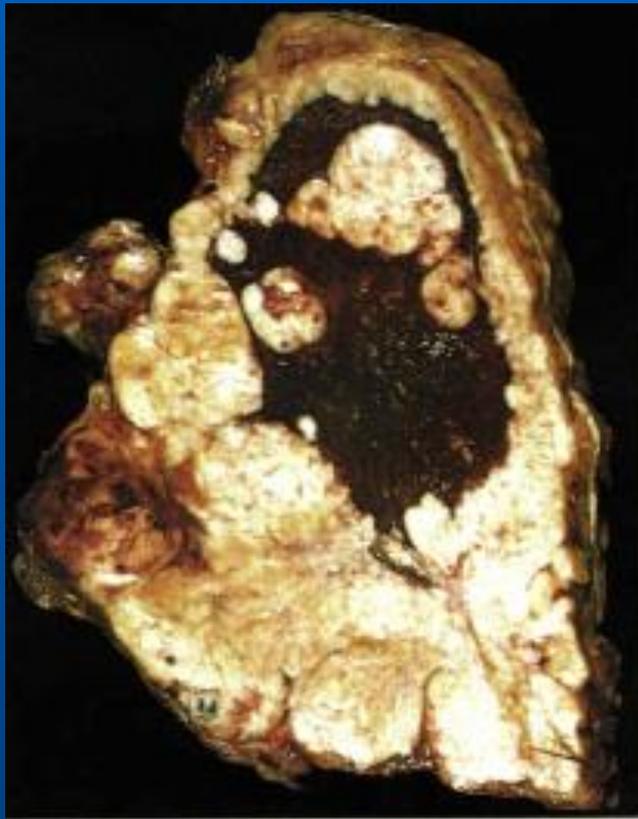
# Asbestos and smoking

- **Asbestos and smoking interact in a multiplicative manner**
- **Decrease in the risk of lung cancer when exposure to either agent is stopped**
- **The majority of smoking-related tumours are SCC from upper lobes of lung**
- **Asbestos related tumours are adenocarcinomas from lower lobes and associated with areas of fibrosis**
- **In contrast no increase risk of mesothelioma in asbestos workers who smoke**

# Mesothelioma

- Asbestos : major risk of mesothelioma
- Latency period: 30-35 years (short –term 1-2 y)
- **Clinical features:**
  - Chest pain, dyspnea, weight loss, cough, fever, Pleural effusion, CXR; unilateral fluid
- **Diagnosis;** pleural fluid is exudative , hyaluronic acid in fluid
  - CXR, CT, biopsy (spindle cell type)
- **Average survival:** 12 months
- **Treatment:** No effective treatment, palliative care, surgery, chemotherapy, radiotherapy

# Malignant Mesothelioma



# Bladder Cancer

- Occupational risk e.g. aromatic amines manufacturing, rubber, leather workers, painter, truck drivers, Aluminium workers: 21-27%
- Cigarette :47%
- Transitional cell carcinomas
- Latency period: From 4 to 45 years

# Prevention

- **Early detection: Urine cytology , 70% sensitivity and 95% specificity (asymptomatic individuals)**
- **Cytoscopy (symptomatic)**
- **DNA flow cytometry, image analysis to detect nuclear aneuploidy, IHC for p53**
- **Hematuria screening by urinalysis or dipstick**
- **Tests of genetic factors: Tumor suppressor gene combination of cystoscopy and cytology**
- **Survival: depends on grade & stage**
- **Localized disease =95%, distant disease = 0**

# Screening program

1. **Low exposure group: Cytologic examination & Hematuria testing at 6 months intervals for the first 2 years**
2. **High risk population: cystoscopy (if cytology/ hematuria +)**

# Ionizing radiation and cancer

- **Skin cancer : the first cancers detected in x-ray workers**
- **Radiation –induced leukemias among radiologists and radioisotope workers**

# Radiation-Exposed Populations

- **Atomic Bomb (Japanese survivors)**

- **Occupational exposures**

**Radiologists**

**Underground miners**

**Radium dial painter**

**Nuclear workers**

**Radiation technologists**

- **Medical exposure**

**Patients under radiotherapy (Cervical cancer, Breast cancer, ankylosing spondylitis, Hodgkin's disease, Childhood cancer)**

# Skin cancer

- In 1775 ▶ Development of skin cancer (SCC of scrotum), associated with chemical exposure
- Arsenic ▶ SCC, BCC
- coal tar ▶ SSC
- vinyl chloride
- Smoking of tobacco ▶ SCC
- Sun light (UV) ▶ Non –melanoma skin cancer (NMSC)

# Arsenic and skin cancer

- 1) Occurrence of arsenical hyperkeratosis, hyperpigmentation which occurs in lower doses of skin cancer.
- 2) Occurrence of multiple skin cancer in areas not exposed to the sun.
- 3) Skin cancer at young age.

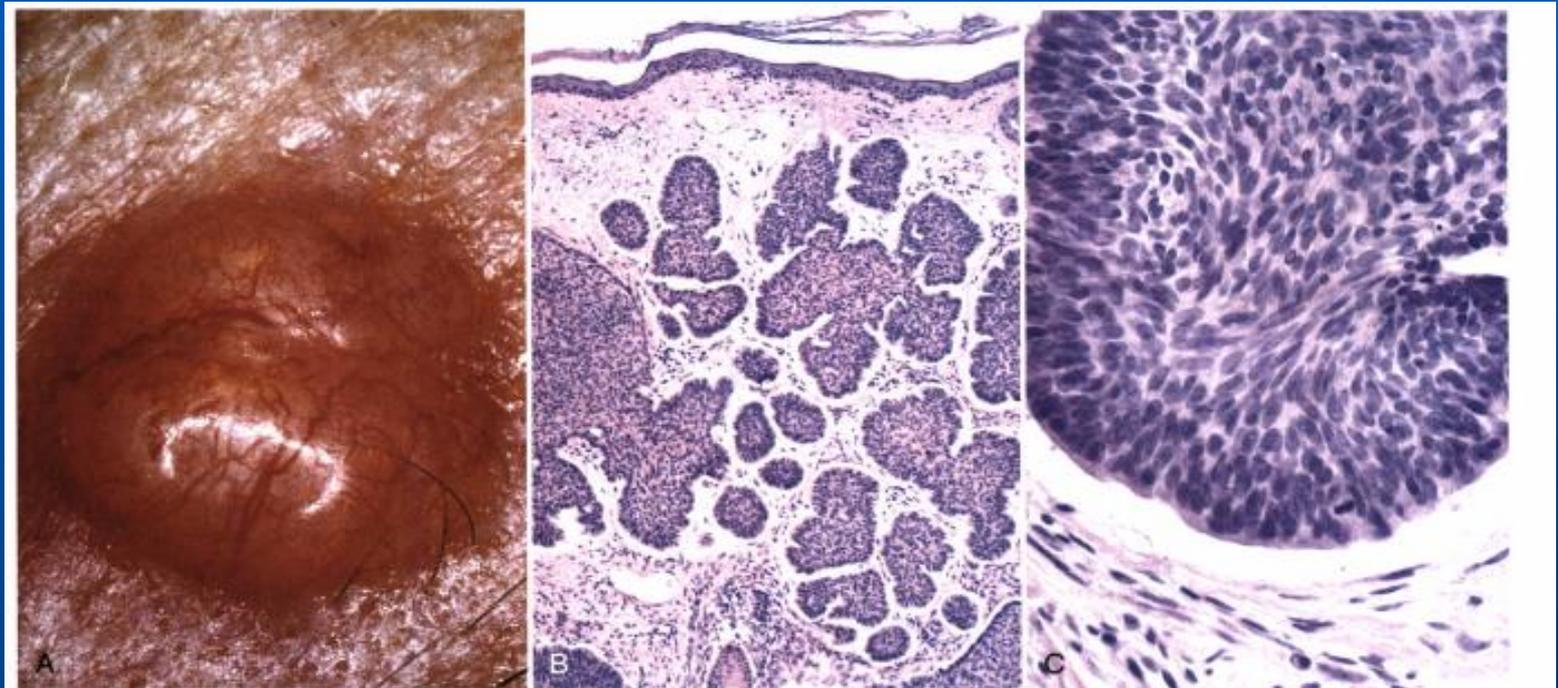
# Sunlight (UV) and skin cancer

- Skin cancer incidence is rising (1/3 of cancers in USA, most common cancer in men in Iran)
- Non melanoma Skin Cancer (BCC 80%, SCC 20%)
- Mortality is low (54000 cases last year, 7000 death)
- In regions with high solar radiation
- exposure to sunlight for occupation (outdoor workers; farmers, sailors)
- Exposure areas: head, neck, face and arms

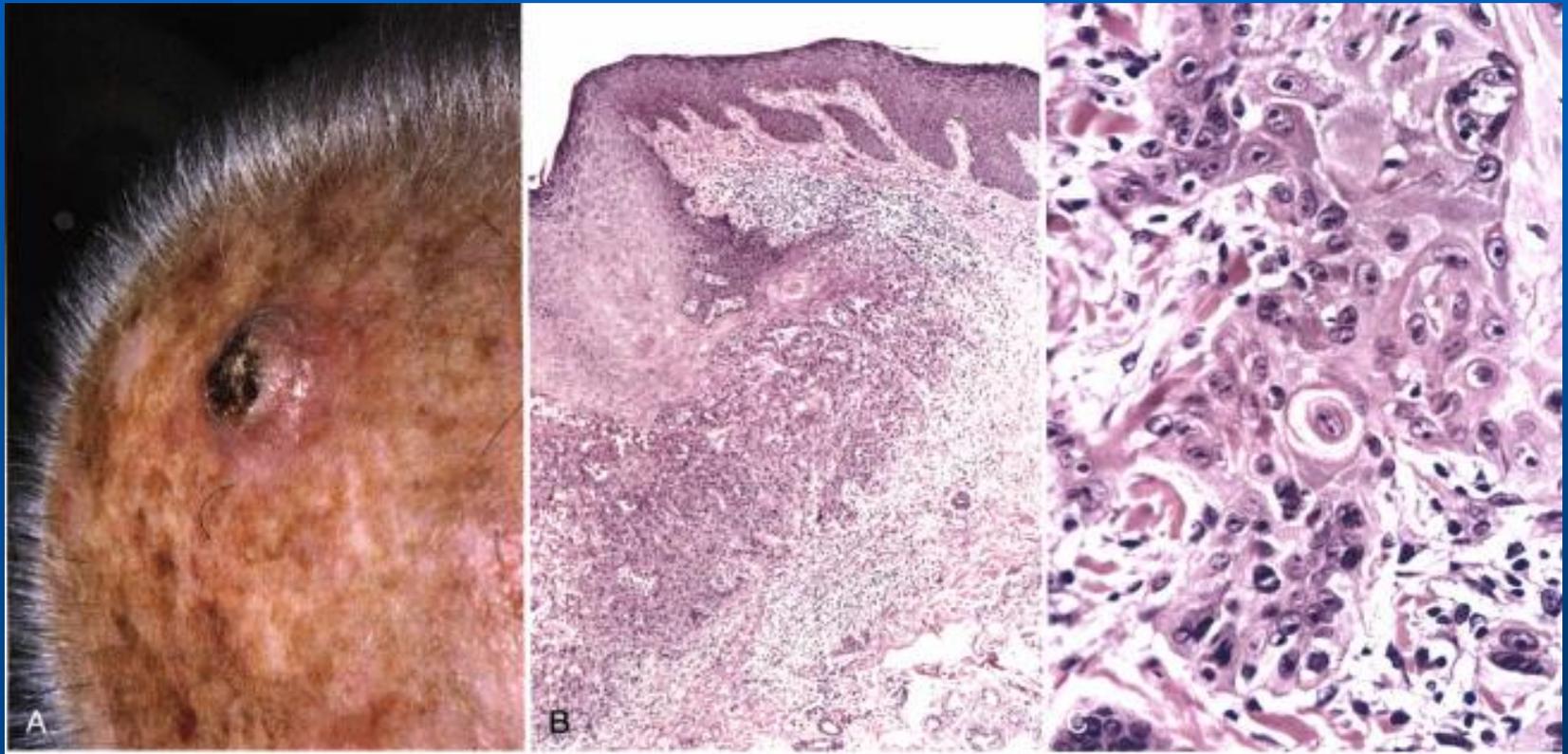
# Risk Factors

- Fair skin, blue eye, blond hair
- Skin sensibility to sun
- Older age
- Immunosuppression
- History of sunburns
- Cumulative exposure to UV radiation

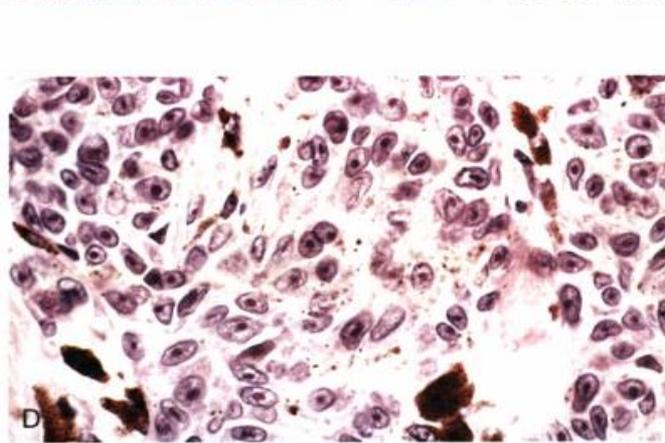
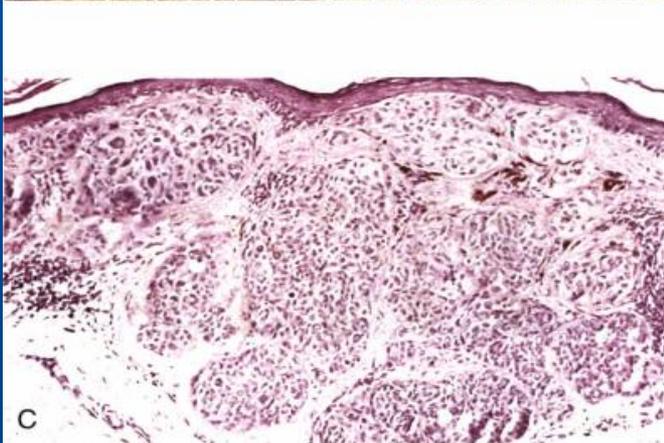
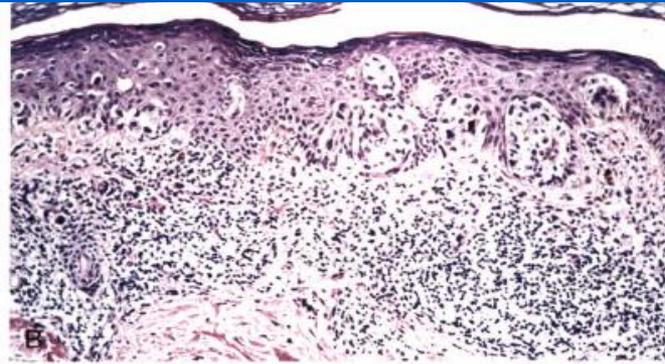
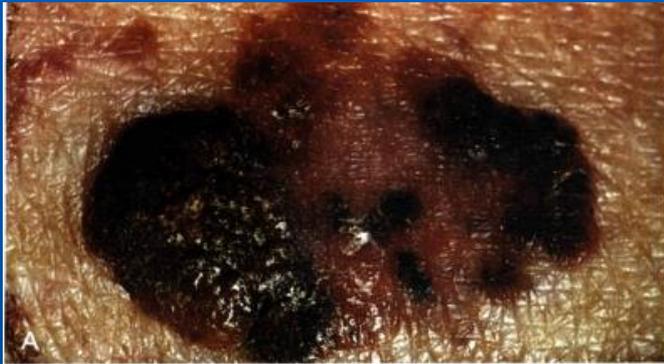
# Basal Cell Carcinoma



# Squamous Cell Carcinoma



# Malignant Melanoma



# Prevention of occupational skin cancer

- Protective clothing (hat, sunglasses)
- sunscreen → 78% reduction
- Zinc oxide
- Ionizing radiation by use of gloves, lead container
- Engineering controls: constructed, shield over work area to limit exposure

# Occupational medicine physician duty

1. بررسی کلیه عوامل بالقوه سرطانزای محیط
2. ارزیابی میزان و مدت مواجهه (استخدام) با عامل سرطانزا
3. Latency period: برای هر کارسینوژن متفاوت میباشد.
4. سابقه سیگارکشیدن یا مواجهه با دود سیگار

passive smoking

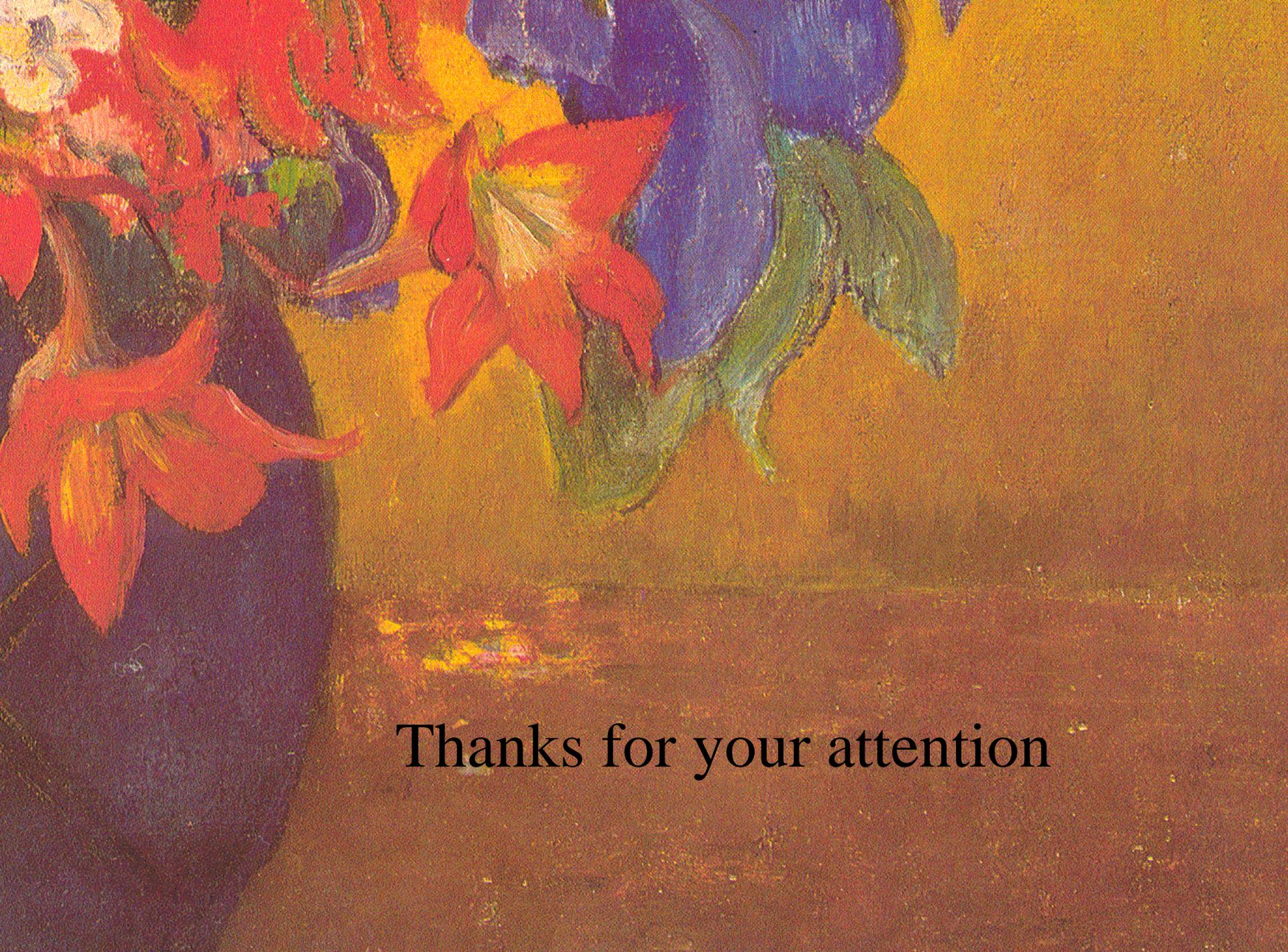
# Medical Monitoring

معاینه افراد در معرض مواد سرطانزا شامل:

1. پایش بیولوژیکی میزان مواد شیمیایی یا متابولیت های انهدار بافتهای بدن (ادرار, هوای بازدمی, خون, مو و عرق)
2. پایش اثر بیولوژیکی : اندازه گیری اثرات بیوشیمی
3. مراقبت های سلامتی : معاینه فیزیکی , CXR, ILO rating, sputum cytology (arsenic, coke ), CT

# Prevention of Occupational Cancers

1. آزمایش سرطانزائی مواد شیمیایی قبل از عرضه به بازار
2. حذف یا به حداقل رساندن مواجهه با مواد سرطانزا
3. آموزش افراد برای حفاظت از خود و آشنائی با خطرات احتمالی
4. غربالگری افراد با ریسک بالا ( سیگاری ها )
5. غربالگری ژنتیکی
6. مانیتور کردن محل کار جهت شناسائی عوامل سرطانزا موجود در محیط
7. توصیه به رژیم غذایی صحیح و استفاده از میوه و سبزیجات , ترک سیگار



Thanks for your attention