

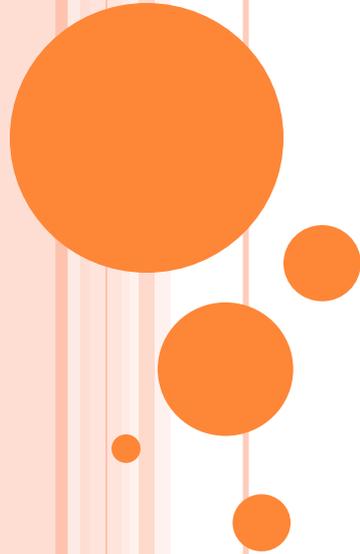


SILICOSIS

دکتر زیبا لوک زاده

متخصص طب کار و بیماریهای شغلی

دانشیار دانشگاه علوم پزشکی شهید صدوقی یزد



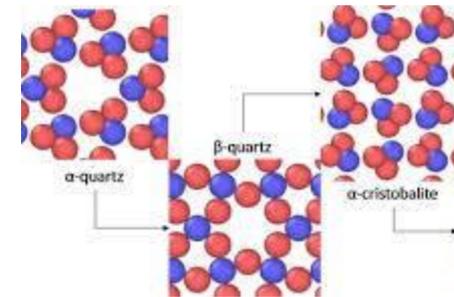
SILICA OR SILICON DIOXIDE (SiO₂)



- Free silica: only SiO₂
- Silicate: SiO₂ in combination with other elements
- Forms of silica or silicon dioxide (SiO₂)
 - crystalline (polymorph)
 - non-crystalline (amorphous)
- Amorphous silica is considered to be of low toxicity, although studies are somewhat limited and health concerns remain.

○ Crystalline silica (polymorphs) include:

- α -quartz
- β -quartz
- tridymite
- cristobalite



- By far polymorph the most abundant is α -quartz, which is a constituent of many soils, sands and rocks, and the usual exposure in workplaces and the environment



SOURCES OF EXPOSURE

- Activities in which sand, stones or rocks or materials containing them are moved, crushed, milled, processed, drilled, ground, polished, cut or collide have the potential to generate exposures.
- The major silica-associated diseases result from inhalation of **respirable crystalline silica (RCS)**; activities and settings in which fine dust is present in the air are important.



SOURCES OF OCCUPATIONAL EXPOSURE TO RESPIRABLE CRYSTALLINE SILICA

- Moving, drilling, working, processing, crushing, milling sand, stones or rocks
- Mining and milling
- Agriculture
- Ceramics
- Glass manufacture
- Construction
- Stone-working
- Abrasive blasting with sand (sandblasting)
 - also unusual applications (e.g. sandblasting jeans and cooking pan manufacture).





SANDBLASTING



OCCUPATIONAL EXPOSURE LIMITS

حدود مجاز مواجهه شغلی – وزارت بهداشت، درمان و آموزش پزشکی

۱۰۰

مبنای تعیین حد مجاز مواجهه	نمادها	حد مجاز شغلی		وزن ملکولی	نام علمی ماده شیمیایی
		STEL/C	TWA		
ادم ریوی	-	-	۰/۰۵ ppm	۱۹۲/۹۶	هگزا فلوراید سلنیم Selenium hexafluoride [۷۷۸۳-۷۹-۱], as Se
تحریک سیستم گوارشی	A۴		۱۰ mg/m ^۳	۳۰۹/۱۳	سزون Sesone [۱۳۶-۷۸-۷]
فیروز و سرطان ریه	A۲	-	۰/۰۲۵ mg/m ^۳ (R)	۶۰/۰۹	سیلیس؛ کریستالین، آلفا کوارتز و کریستوبالیت Silica, Crystalline- α -Quartz [۱۳۱۷-۹۵-۹]; [۱۴۸۰۸-۶۰-۷] and cristobalite [۱۴۴۶۴-۴۶-۱]



POTENCY FACTORS

- Reduce toxicity:
 - aged quartz
 - use of wet processes
 - presence of aluminium-containing clay minerals
- Increase toxicity:
 - freshly fractured
 - Fine
 - dry silica
 - un-associated with clays



DISEASES ASSOCIATED WITH RCS

○ **Pneumoconiosis**

- Chronic silicosis
- Accelerated silicosis
- Acute silicoproteinosis
- Progressive massive fibrosis
- Rheumatoid silicotic nodules (Caplan's syndrome)

○ **Airways Disease**

- Chronic bronchitis
- COPD
- Emphysema
- Mineral dust airways disease



DISEASES ASSOCIATED WITH RCS

- **Mycobacterial Disease**
- **Lung Cancer**
- **Autoimmune Diseases**
 - Scleroderma
 - SLE
 - Rheumatoid arthritis
 - Chronic Renal Disease
 - Cardiovascular Disease



- The diagnostic work-up typically involves:
 - an exposure history covering all jobs
 - symptoms, including those associated with TB
 - physical examination with attention to features that would be unusual in silicosis (e.g. clubbing, enlarged lymph nodes, hepatomegaly, splenomegaly, rashes and inflammation of small joints)
 - chest radiographs: HRCT scans would be usual in many developed countries
 - spirometry



CLINICAL FEATURES OF SILICOSIS

- The diagnosis of silicosis is based on:
 - a history of sufficient exposure
 - imaging findings consistent with silicosis
 - symptoms and signs and laboratory tests that are suggestive that another disease is not more likely



CLINICAL FEATURES OF SILICOSIS

- The diagnosis of silicosis can be made reasonably confidently without further investigation when:
 - there is a history of prolonged RCS exposure
 - the patient has the typical small, rounded opacities in the upper lung zones
 - the patient is well without systemic symptoms such as weight loss, fever or signs suggesting another disease



SUFFICIENT EXPOSURE

- The risk of the silica-associated diseases is a function of **intensity** and **duration** of exposure, rather than duration alone:
- In settings of low exposure:
 - The silica-associated lung diseases require prolonged exposure, typically ≥ 20 years)
- In poorly controlled settings:
 - Diseases may manifest after only a few years of exposure (accelerated silicosis)



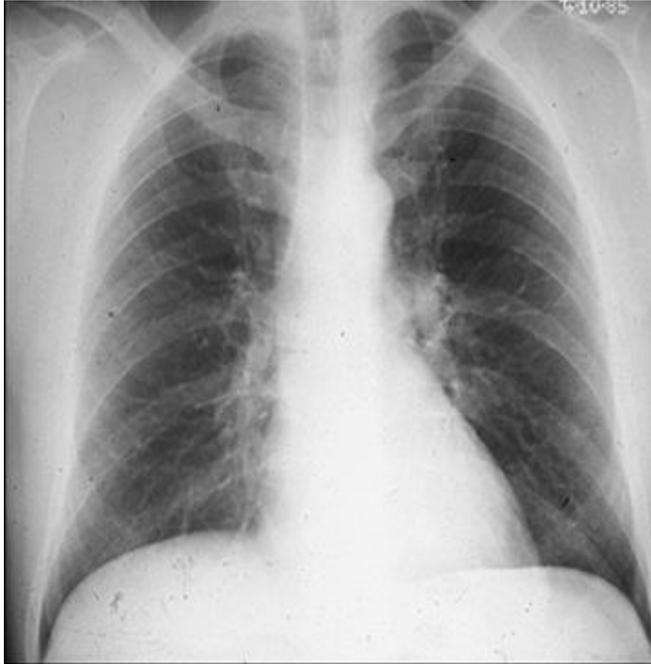
- Visible dustiness can be misleading
- confirming the presence of *respirable* particles is useful
- historic measurements may be available in order to provide this information
- The use of respiratory protective equipment may produce a false sense of protection, as inappropriate or inadequately used respirators are commonplace



IMAGING

- Chronic (typical) silicosis:
 - **small** (typically 3–6 mm diameter, ranging from 1 to 10 mm), **rounded nodules** with a posterior and upper zone predominance on chest radiography, which may calcify in up to 20% of cases
 - Mediastinal and hilar lymph node calcification is common in silicosis; the calcification is often ‘egg-shell’ in morphology . This feature may predate the pulmonary parenchymal nodularity



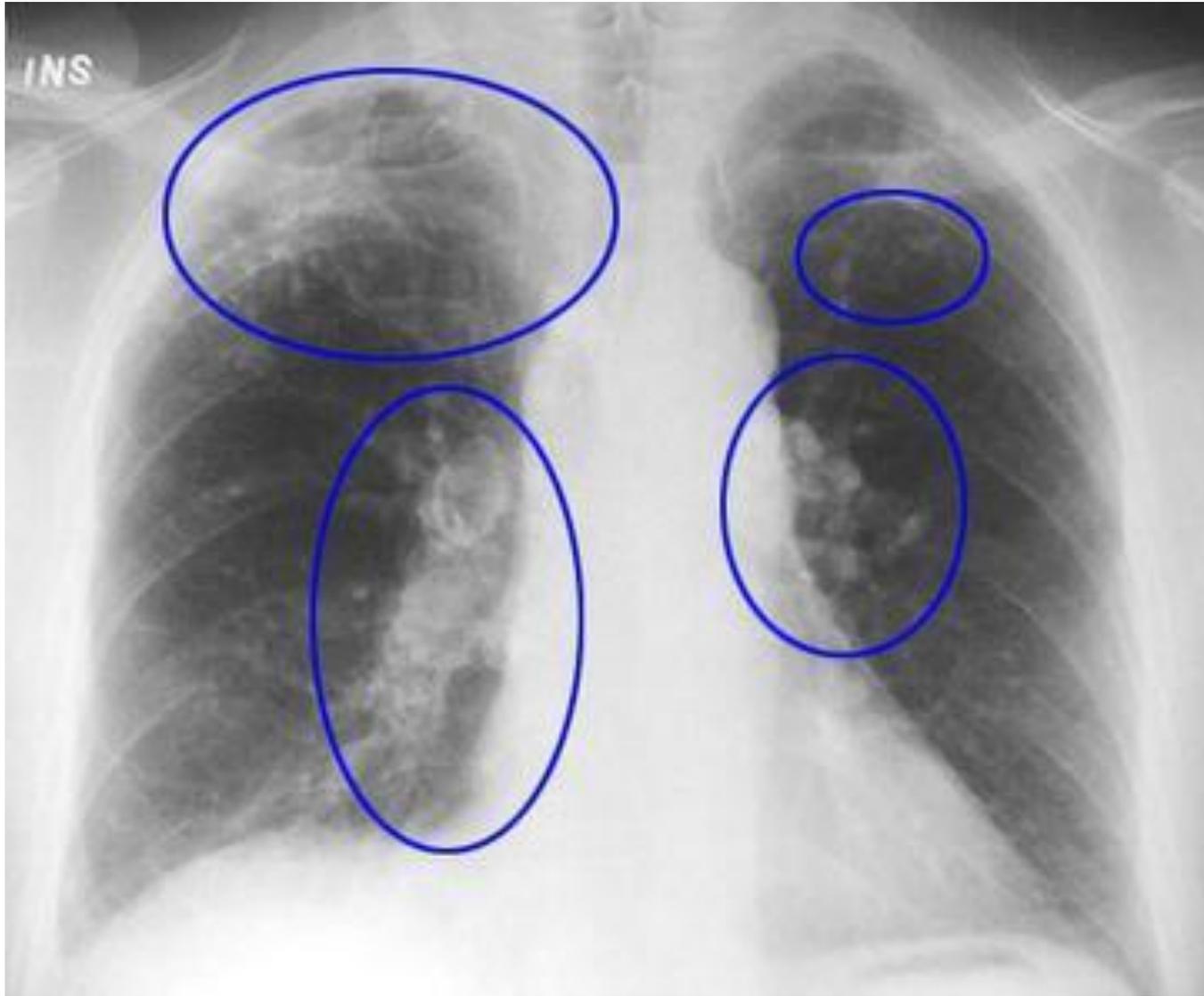


normal



silicosis

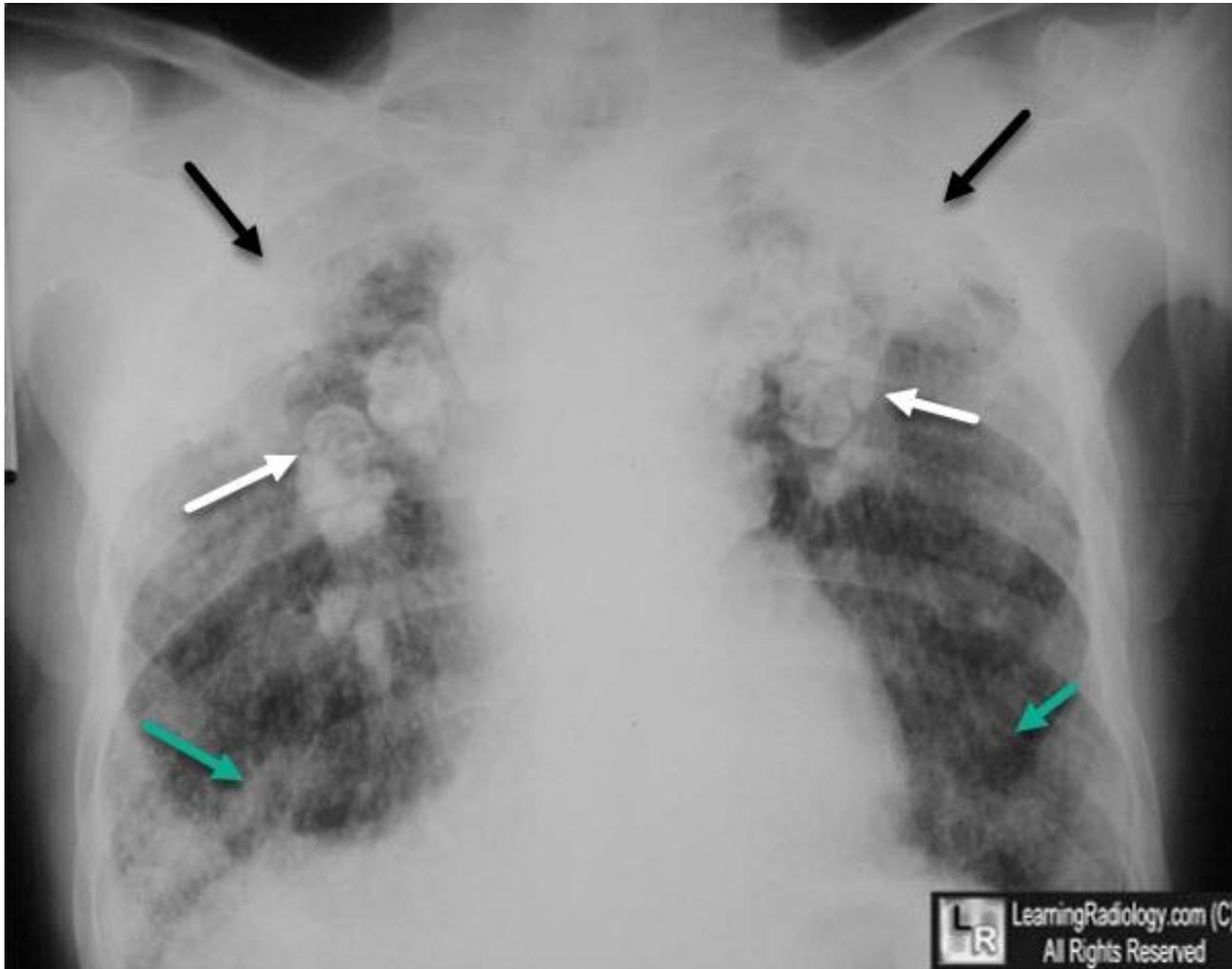




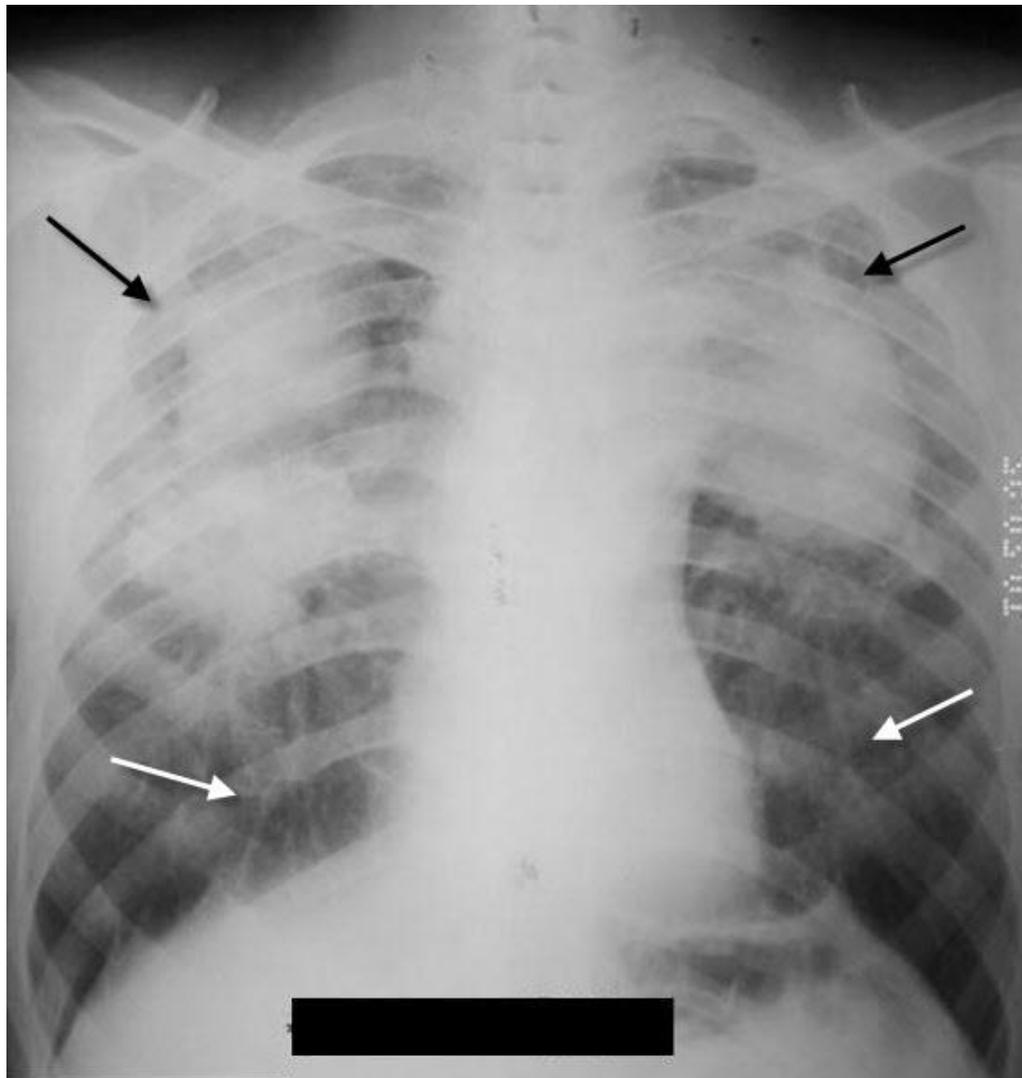
PROGRESSIVE MASSIVE FIBROSIS (PMF) RADIOLOGICALLY

- lesions of PMF are rounded or oval, with densities of at least 1 cm in diameter
- Upper zone predominance is the rule
- tend to occur in the periphery of the lung and migrate centrally over time
- Both unilateral and bilateral densities (either symmetrical or asymmetrical) have been described





- Silicosis with Progressive Massive Fibrosis. There are large conglomerate upper lobe "masses" (black arrows). Multiple enlarged and calcified hilar lymph nodes are seen, many with rim-like or "egg-shell" calcification (white arrows). There is scarring in both lower lobes (green arrows).



- Progressive Massive Fibrosis. There are conglomerate soft-tissue densities in both upper lobes (black arrows) with linear scarring leading from the lower lobes (white arrows).

SYMPTOMS & SIGNS

- Chronic silicosis, even when radiologically advanced, may be symptomless
- such patients have worked in dirty workplaces, may have smoked, have had previous TB or have other diseases due to RCS; therefore, respiratory symptoms and signs are not uncommon.



SYMPTOMS & SIGNS

- cough, with or without sputum
- dyspnoea
- wheezes or crackles on auscultation



LUNG FUNCTION TESTS

- Lung function tests can be normal even in radiologically advanced disease
- There is no specific lung function change associated with silicosis, and obstructive, restrictive or mixed patterns can be observed
- DLCO should be measured in cases with discordance between dyspnoea and spirometry



PROGRESSION

- Silicosis often progresses whether or not RCS exposure continues after diagnosis
- Continued exposure was associated with increased risk:
 - PMF
 - more advanced silicosis, large opacities
 - TB



TUBERCULOSIS

- Silicosis substantially increases the risk of TB: approximately **three** times
- Silica exposure without silicosis has been shown to be a determinant of TB, but the relationship is less certain than for silicosis
- The clinical features:
 - may be the same as for TB in individuals without RCS exposure



TUBERCULOSIS

- Some of radiologic features that should prompt further clinical evaluation are:
 - short latency from first RCS exposure to appearance of opacities
 - variability in size and shape and asymmetrical distribution of opacities
 - supra-clavicular opacities
 - regional aggregation of irregular-sized nodules
 - mediastinal lymphadenopathy
 - appearance of large opacities



PREVENTION



1-CONTROLLING EXPOSURE

- Substitution of silica with less harmful materials
 - scouring powders and non-silica foundry sands, is possible for some applications
- Engineering controls
 - would be cost effective in both developed and developing countries
 - complex and require the knowledge
- Respirators:
 - they must be fit-tested for workers
 - maintained and stored appropriately and replaced at the correct intervals



2- SURVEILLANCE

- Health surveillance
- Medical evaluation of current and former co-workers of the sentinel cases



HEALTH SURVEILLANCE

- Health surveillance of workers in RCS workplaces is widely recommended on:
 - Placement
 - Periodically
 - Near exiting employment
- Health surveillance (**annually**) concluded:
 - Health questionnaires
 - Physical examination
 - Spirometry
 - CXR
 - The American College of Occupational and Environmental Medicine recommend that workers with RCS exposure:
 - a baseline evaluation
 - again at 1 year
 - then 3-yearly for the first 10 years
 - 2-yearly thereafter



TREATMENT AND MANAGEMENT

- Silicosis is incurable; no treatment has been shown to be consistently effective in reducing fibrosis or preventing progression
- There is no consensus that treatment of TB should be modified in patients with silicosis
- Removal from further exposure to RCS is generally recommended following the diagnosis of silicosis in order to lower the risk of progression and complications such as TB





از حسن توجه شما سپاسگزارم