

Occupational Medicine Clinical Update

Dedicated to the prevention of occupational illness and injuries, and promoting the well-being of all workers

Occupational Health Clinics for Ontario Workers Inc, Samia-Lambton

Silica-related disease: Are our heads in the sand?

This Issue:

- Silica-related diseases

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You are reviewing the chart of your next patient. Your suspicions regarding Mr. S are confirmed as you read the rheumatologist's report, "Given the arthritic changes, positive ANA and anti-DNA, pleural effusions and ECG changes this man has sufficient criteria to satisfy the diagnosis of Lupus."

Thanks to a cancellation, you have a few minutes before Mr.S arrives. You thumb through the chart - Family History: negative for autoimmune disease. Occupation: sandblaster.

Since you are curious you go to PubMed at www.ncbi.nlm.nih.gov/entrez/query.fcgi and type "sandblasters and lupus" and find 3 articles. Clicking on related articles gives you 108 more. They mainly seem to focus on silica...

"It's everywhere"

Silica (Si) is a substance that many of us, as physicians, know very little about and yet it is

ubiquitous in our environment and many workplaces. It is the most common mineral on earth, with 90% of the planet's crust made up of Si in either amorphous (flint or diatomaceous earth) or crystalline (quartz, tripoli, tridymite, and cristobalite) form. Crystalline silica is generally considered to be more toxic than amorphous silica.

The highest exposures to Si have been in the classic 'dusty industries' - mining, quarrying and masonry. However, as can be seen in Table 1 below, exposure to crystalline silica occurs in a large number of occupations and industries.

Despite what is known about the hazards of silica exposure (see Table 2 following page) silicosis is still a relatively frequent occurrence [Kriebel, 2001]. This may be due to a number of factors: monitoring is rarely performed and levels frequently are significantly above allowable limits. Farmers, in particular, have been shown to be exposed to respirable levels of Si dust in excess of regulatory limits [Parks, 2002]. Compounding the problem is low fines for infractions.

Table 1: Occupations Associated with Crystalline Silica Exposure*

Occupation/ industry	Specific tasks
Abrasives	Silicon carbide production, abrasives production
Agricultural chemicals	Raw material crushing, handling
Auto repair	Abrasive blasting
Ceramics	Mixing, molding, glaze or enamel spray/finish
Construction/mining/quarrying/ drilling/tunneling	Abrasive blasting, stone cutting, earth moving, masonry, concrete work, demolition
Dental material, jewelry	Abrasive blasting, cutting, grinding, polishing
Foundries and other metal/ milling processes	Abrasive blasting, casting, many other processes
Glass/fiberglass	Raw material processing (sand, quartz), furnaces
Plastics and rubber	Raw materials handling (fillers)
Shipbuilding, repair	Abrasive blasting

Beyond silicosis

The dangers of silica have been recognized since the time of Hippocrates. Agricola (1494-1555) gave this accounting of the experience of Bohemian miners in the mid-1500's:

...the dust, which is stirred and beaten up by digging, penetrates into the windpipe and lungs and produces difficulty in breathing and the disease the Greeks call asthma. If the dust has corrosive qualities, it eats away the lungs and implants consumption in the body. In the Carpathian mines, women are found who have married seven husbands, all of whom this terrible consumption has carried away.

We are all familiar with the term silicosis (in it's various forms-see Table 2) and are generally aware of the related pulmonary diseases. These include COPD and opportunistic infections such as TB which Si exposed workers are specifically at risk for [ATS, 1997]. Few of us, however, may be aware that in 1997 the International Agency for Research on Cancer (IARC) classified inhaled crystalline silica as a human carcinogen
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* Adapted from Parks [1999], a more comprehensive list is available on request.

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(group 1). This was based on Si's link to lung cancer [Steenland 2001].

Maybe even more surprising is the body of evidence linking Si and autoimmune diseases. The literature for scleroderma (SS) has been accumulating since the 1950's and currently the WSIB accepts SS as an occupational disease related to silica dust exposure. There is also considerable evidence linking silica to other autoimmune diseases including: SLE, RA, GN. This evidence has been coming from both epidemiological and experimental studies [Parks, 1999].

Given the strength and relative consistency of the findings it has been suggested that a history of Si exposure in patients with autoimmune diseases should be sought and if present, the exposure should be stopped [Koeger et al, 1995].

It has been suggested that any silica exposure, in patients with autoimmune diseases, should be stopped

Silica has also been recently linked to sarcoidosis. Icelandic researchers found an extremely high odds ratio (13.2, 95% CI = 2.02 to 140.9) between sarcoidosis and occupational exposure to crystalline silica [Rafnsson, 1998]. There was also an indication of a dose-response relationship.

There have also been studies suggesting an association between Si and pancreatic cancer. A meta-analysis of 92 studies (published between 1969-98) with verified exposures was performed by Ojajarvi et al [2000]. They found a meta-risk ratio (MRR) of 1.4 (95% CI=0.9-2.0).

Future Trends

As a result of the proven link between lung cancer and silica, and high rates of silicosis, there has been a call for the reduction of current exposure limits to crystalline silica [Kriebel 2001].

There are many fronts on which research into Si and autoimmune disease may proceed. One interesting suggestion is to examine the predictive value of autoantibodies in silica-exposed occupational cohorts. This kind of information, along with a better understanding of the mechanisms by which silica operates in autoimmune diseases, may eventually result in strategies for prevention or treatment.

Table 2: Diseases Associated with Crystalline Silica Exposure

Disease	Comment
Silicosis	Acute, chronic, simple, accelerated Dose-response relationship
COPD	Clinically indistinguishable from tobacco-related or other etiologies
Infections	TB and nontuberculous mycobacterial disease
Lung Cancer	Declared Class A carcinogen by IARC 1999
Autoimmune	SS, RA, SLE, ANCA vasculitis/GN
Sarcoidosis	Based on one case-control study
Pancreatic Cancer	Meta-analysis of studies: MRR 1.4

Mr. S enters the office and winces slightly as you shake his hand, "Sorry Doc, they're a bit sore today. So, what's the story?" You spend several minutes explaining the rheumatologists findings.

"Lupus? Well how the heck did I get that?"

References

Parks CG, Conrad K, Cooper GS. 1999. Occupational exposure to crystalline silica and autoimmune disease. *Environ Health Perspect.* Oct;107 Suppl 5:793-802.

Kriebel D, Rosenberg BJ. 2001. Lung cancer: another good reason to control silica. *Cancer Causes and Control.* 12: 785-787.

Ojajarvi IA, Partanen TJ, Ahlbom A, Boffetta P, Hakulinen T, Jouvenkova N, Kauppinen TP, Kogevinas M, Porta M, Vainio HU, Weiderpass E, Wesseling CH. 2000. Occupational exposures and pancreatic cancer: a meta-analysis. *Occup Environ Med.* May;57(5):316-24.

There are 18 additional references used in this review that are available on request but not provided due to space constraints.



Sandy Kirkley, M.D.



Michael Kirkley

In Memoriam

The London medical community, and the greater community at large, was shocked by the tragic accidental deaths of Dr. Sandy Kirkley and her husband Michael. Sandy had already acquired a long list of professional accomplishments at a very young age. Mike had also seen tremendous success as a professional football player, and in recent years, a businessman.

The greatest loss with Mike and Sandy has been the personal one: for their two children, the family, and the friends they have left behind. As great and mercurial as their professional achievements were, they were both far greater people than all of their accomplishments. Those of us who had the privilege of associating with the Kirkley's will attest to this in their own very personal way.

Sandy and Mike will be sorely missed and never forgotten by those that knew them, and by the many others that will be inevitably touched by their legacy.