Silicosis in Horses

In the scenic foothills of the Central coast of California, there lurks a quiet problem that can lead to severe disease in our horses. Commonly known as ‘chalk rock’, this dusty rock form can cause an irreversible lung condition known as silicosis.

Silicosis is a well known occupational disease in humans, typically caused by inhaling rock dust created in mining, masonry work, sandblasting, and many other industries where rock is crushed into an easily-inhaled dust.

In horses, the disease was first diagnosed in the late 1970s in the Monterey-Carmel area. Before this time, area veterinarians had noted signs of respiratory disease, but had been unsure of its cause. For years, silicosis in horses was believed to be isolated to this small region. But as awareness of the disease increased, cases started to be diagnosed in other parts of the state.

What causes silicosis?

Briefly, silicosis is caused by inhaling silica dust small enough to travel all the way into the smallest airways and air sacs in the lung. Some sources incompletely describe silicosis as a lung disease caused by inhaling quartz dust. As will be discussed in the section titled Silicates, other crystal forms of silica can also cause silicosis. Once the dust particles become lodged in the lung, the body mounts a strong immune reaction. While bacteria or pollen can be broken down and removed from the lung, silicates can not. This causes an ongoing process which can lead to scarring of the lung, and, in people, certain auto-immune disorders.

History

In humans, silicosis is a fairly well understood but frustrating disease. Even now, there is no cure. Occupational safety measures have dramatically decreased the incidence of the disease, but cases still occur.

The most notorious occupational incident occurred in the early 1930s when at least 700 workers died from silicosis. Workers came from all around to tunnel through a mountain in Gauley Bridge West Virginia, eager for any type of work during the Great Depression. The tunnel was to be used to carry water for a new hydroelectric plant. Although it was well understood at the time that silicosis was a risk if dry-drilling was used, the contractors chose this method over the much safer, but slower, wet-drilling technique.

As an occupational disease, silicosis may have been recognized by ancient Egyptians, and was described well by Agricola in 1556.
Silicates

Silicates are crystalline forms of the element silica. By far the most widespread crystal of silicate is quartz, which is present in most rock types. The form which causes silicosis in horses is cristobalite. Cristobalite causes a more severe reaction in the lung than quartz does. This crystal is present in abundance in the Monterey/Carmel Valley areas. Geologists refer to this particular deposit of rock as the Monterey Formation. Although this rock type is common in this region, it is present from Point Reyes to San Onofre in the coastal ranges, with outcroppings in the San Joaquin valley, and as far south as Baja California.

The Monterey Formation developed in shallow seabeds during the Miocene epoch (between 5 and 20 million years ago) from deposits of microorganisms known as diatoms. Diatoms have a non-crystalline form of silica in their structure which, over millions of years, becomes compressed into crystalline forms. Initially, the crystal formed is cristobalite, but with more time, quartz can be formed. Many of the soils of the Monterey Formation have high levels of cristobalite.

These soils are often referred to as ‘chalk rock’ locally, as they tend to be dusty and light. (True chalk is actually limestone, which contains no silica.) Geologists refer to some of the various subsets of the Monterey Formation as porcelanite, chert, siliceous mudstone, and siliceous shale. For the rest of this article, the term siliceous soils will be used.

Cristobalite can also be formed through volcanic activity. The Sonoma volcanic soils are a likely source of the cristobalite responsible for silicosis in horses from this region.
Exposure
Areas with siliceous soils are typically in foothill areas. Often, cases are seen not long after recent construction has disrupted the soil, creating a dusty environment. The horses inhale the dust over days to months or even years. Depending on a variety of factors, affected horses may show no signs or could develop severe respiratory compromise. Rate of exposure and individual immune response probably play the biggest roles in terms of severity of signs.

Clinical Signs
Affected horses will sometimes develop a cough, an elevated respiratory rate (normal resting rate for a horse is typically around 8-16 breaths per minute), flared nostrils at rest, and/or exercise intolerance. It is very important to remember that these signs are typical of respiratory compromise in general, so are not specific for silicosis.

Diagnostics
Lung x-rays are the simplest test to perform to diagnose silicosis. Abnormal x-rays exhibit classical signs for silicosis in advanced cases. Early or mild cases may have subtle, non-specific lung x-ray findings.
Samples of fluid and cells from the lungs can be obtained in two ways: a trans-tracheal wash, or a bronchoalveolar lavage (BAL). Affected horses may exhibit pink crystals within a type of white blood cell called a macrophage. The crystals are silicate crystals, and the macrophages are the cells that attempt to destroy or remove the particles. At Steinbeck Country Equine Clinic, we typically choose the BAL technique for this diagnosis.

Ultrasound is occasionally useful in imaging silicosis cases, particularly with advanced cases. Most silicosis changes are deep within the lung, and the ultrasound beam does not penetrate through the air present within the lung, so less advanced cases do not show up well.

Treatment

In horses, as in humans, there is no cure for silicosis. Treatment involves removing the horse from the silicate dust as well as from other types of dusty or moldy environments. In mild to moderate cases, short courses of steroids and bronchodilators can get a horse through a flare-up. Affected horses may not be able to regulate their temperature, so it is important during hot weather to provide shade, or other means to create a cool environment.

Silicate Associated Osteoporosis

In horses living on siliceous soils, certain bone deformities and fractures can develop. Horses with silicate associated osteoporosis can develop signs years after moving away from an area with siliceous soils. This disease typically occurs in horses with a longer-term exposure to silicate dust. The bones develop osteoporosis which, as in people, can predispose to fractures. Horses typically develop bowed shoulders, a swayed back, and often a stiff neck secondary to osteoporosis and secondary arthritis in the cervical spine, although early cases have no obvious outward signs.
Body soreness and exercise intolerance are common in horses with silicate associated osteoporosis, and some horses may develop neurologic signs. Fractures are most common in the spine, ribs, pelvis and shoulder blades. Affected horses may or may not have respiratory signs, but will typically have some degree of respiratory involvement.

Diagnosis of silicate associated osteoporosis is simple in advanced cases, where outward signs alone are diagnostic. In mildly affected horses, diagnosis is challenging, because vague lameness or stiffness may be the only signs (as can be seen in countless other disease processes). In these cases, nuclear scintigraphy (bone scan) is very sensitive at detecting the disease. Ultrasound of the shoulder blades and x-ray images of the neck can help define the disease as signs progress, but will often be normal in early cases.

Treatment for silicate associated osteoporosis with typical anti-inflammatories such as phenylbutazone is often minimally effective. Sometimes steroids will improve the comfort level, but not always. Intravenous Legend® can help with the arthritis pain in the neck that commonly develops, but does not help with bone pain. Tildren® may help decrease bone pain and possibly stop the progression of osteoporosis. Tildren® is in the same family of drugs as Actonel®, Fosamax®, and Boniva®, which are used to treat osteoporosis in people. Recently, zoledronate (Zometa® or Reclast®) has been used experimentally at UC Davis, with promising results.

Prevention of Silicosis

Prevention of silicosis requires limiting the amount of inhaled silicate dust. Areas of new construction should be avoided. Dry lot situations should be altered as much as is possible. The ideal solution is to plant grass over the area and irrigate throughout the summer months, but this is often very impractical. Incorporating organic material into the soil can help to retain moisture and minimize dustiness. Wood chips or composted manure are fairly effective and inexpensive methods. Topsoil brought in from an unaffected area may also be effective.

Future Directions in Silicosis Study

Control of the excessive immune response is the primary direction of research in the human field. In horses, the primary areas of study involve silicate associated osteoporosis. We are currently working in conjunction with researchers at UC Davis on studies to determine the exact nature of the bone disease. Currently, Dr. Murray is studying two blood tests, which appear to be promising in detecting the disease process. With earlier detection and monitoring of bone density, we hope to be able to prevent the catastrophic fractures and other bone-related pain.

Matt Durham, DVM grew up in Reno, Nevada. During the summers growing up, Dr. Durham worked in the Sierra Nevadas as a backcountry guide at McGee Creek and Mammoth Lakes Pack Outfits, where he met his wife, Tiffany. He attended Cal Poly, San Luis Obispo, and obtained a degree in Animal Science. After graduating from veterinary school at UC Davis, he performed a one year internship at Alamo Pintado Equine Medical Center in Los Olivos, California. After four years in practice, he performed a one year fellowship in large animal cardiology and ultrasound at the University of Pennsylvania’s New Bolton Center. Dr. Durham has been at Steinbeck Country Equine Clinic since 2001.