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## Tucker Battles Tetanus—And Wins!

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by Helma Weeks

Tucker, a four-month-old male bullmastiff, spent September at the Ryan Veterinary Hospital, fighting for his life—and winning the battle. His owners, Dr. and Mrs. Arthur Gold, had noticed on September 1 that the young dog seemed to have a different look; his wrinkles had suddenly deepened, his muzzle appeared wider, and his ears were pulled back. The next day, the dog had trouble standing and swallowing, he trembled continuously, and his tail was stiff and carried away from the body.

Alarmed, they took him to **Christopher Keefe, V'97**, their veterinarian in Cherry Hill, N.J. Dr. Keefe made the diagnosis of tetanus, administered intravenous antibiotics, and transported Tucker to Ryan's Emergency Service. Here Tucker received tetanus antitoxin to bind the circulating toxin and thus prevent further toxin binding in the nervous system. "Tetanus is caused by a toxin produced by *Clostridium tetani*, an anaerobic bacterium," says **Dr. Adrienne Bentley**, a Ryan intern and Tucker's primary doctor. "The toxin prevents the release of inhibitory neurotransmitters in the brain and spinal cord, causing the muscles to contract, resulting in limb rigidity. Muscles of the limbs and face, as well as muscles involved in respiration, can be affected. When muscles of the face and jaw are affected, the jaw becomes rigid, and the animal can't open its mouth.

"We administer antitoxin to bind the toxins in the blood. Unfortunately, the antitoxin does not bind with the toxin already in the central nervous system. Binding of tetanus toxin to the inhibitory neurons is irreversible, so recovery depends on regeneration of these neuron terminals, which can take weeks."

*Clostridium tetani* can be found in its dormant spore form in the soil as well as indoors. The bacteria enter the body through a wound deep enough to create anaerobic conditions and then proliferate and produce toxin. Susceptibility to tetanus varies among species and is thought to be related to variability in the toxin's ability to bind to nervous system tissue. Dogs and cats are considered relatively resistant, whereas horses and humans are quite susceptible. As such, horses and humans are routinely vaccinated against tetanus, but no such vaccine exists for dogs and cats. Tucker was

checked for wounds, but none were found.

He was transferred to the Neurology service, and when his muscle rigidity progressed, he was admitted to the ICU, where he was treated aggressively with sedatives and muscle relaxants. "Tetanus patients have to be sedated because any stimulus causes excitement of the nervous system, resulting in muscle contractions," says Bentley. "This in turn causes the body temperature to rise to dangerous levels." When the dog was sedated, clinicians were able to open his mouth and discovered that all four deciduous canine teeth appeared discolored and that the pulp was exposed. "Exposed pulp represents a possible route of entry for the bacteria, and it's possible that one of these teeth was the source of infection," Bentley says. "In the absence of another wound, we recommended removal of these teeth in the event that they represented the route of entry of the organism." The most important aspect of treating tetanus is identifying and removing the source of infection because the bacteria continually produce toxin.

Tucker had a dental procedure to extract the deciduous teeth. A catheter was placed into his jugular vein to allow blood sampling and administration of parenteral nutrition (intravenous feeding). Teeth and tissue samples were submitted to the diagnostic lab to confirm the diagnosis of tetanus and the source of the infection. Cultures failed to grow the clostridium, which is not unusual, as it is an anaerobic organism and the slightest exposure to air will kill the bacteria. Histopathology also was inconclusive. Although the teeth could not be identified as the definite source of the infection, the pathologist identified bacteria that were consistent with clostridial organisms. Tucker's ultimate recovery suggests that the teeth were the source of infection, since he likely would not have recovered without removal

of the source. To date, there are no reports of infected teeth as the source of tetanus. However, the oral cavity is commonly discussed as a possible source of tetanus in puppies that are losing their deciduous teeth.

Tucker was placed in a corner run in the ICU. It was draped and kept dark to reduce external stimuli. Everyone in ICU spoke in hushed voices for quite a few days. The pup received antibiotics, parenteral nutrition, muscle relaxants, and sedatives. Tucker lay on his side and breathed on his own. There wasn't much more that could be done at that point. He needed intensive nursing care, which was

provided around the clock. Six days into the illness, Tucker developed upper airway obstruction due to excessive saliva and mucus production. His mouth was suctioned and he received additional sedatives. Three days later, clinicians radiographed his chest because they were worried that he had developed pneumonia due to his immobile and recumbent state. Although he was turned frequently, this was no substi-



Tucker after recovery and Dr. Bentley.

tute for regular movement and being up on the chest (sternal). Tucker was unable to turn himself or maintain himself in a sternal position because of his muscle rigidity and the sedatives that were administered. The radiographs showed evidence of mild pneumonia, and he received a broad-spectrum antibiotic.

During the night, Tucker's blood gas values deteriorated and he was placed on the ventilator. "We don't know whether the muscles that move the chest wall became fatigued, or if his disease progressed to involve the muscles of respiration," says Bentley. "He needed the ventilator to help him breathe."

Clinicians were also worried that they had not identified the source of the infection because the deterioration in Tucker's breathing

may have represented progression of the tetanus. CT scans were performed to look for an abscess in the mouth and the abdomen. The scans were negative. During the anesthesia for this procedure, Tucker initiated some breaths on his own.

After about 24 hours of mechanical ventilation, his sedation and ventilatory support were decreased. Twelve hours later, Tucker was disconnected from the ventilator because he was able to breathe on his own, and he never looked back.

On Monday, September 15, the muscle rigidity seemed worse, but by the next day he improved. "We think the increased rigidity may have been due to the withdrawal of all sedatives," says Bentley. "It is also possible that recovery from generalized tetanus in dogs has an inherently variable course. We just don't know, since dogs with generalized tetanus like Tucker, in which there is respiratory compromise, rarely recover. The dedication of Tucker's owners and our entire hospital staff, as well as Tucker's cooperative and amiable nature, undoubtedly made his recovery possible. Neurology resident **Dr. Mark Troxel**, the entire Neurology Department, and the ICU faculty and staff were instrumental in Tucker's recovery." The Golds became regulars in the hospital, visiting every day of Tucker's three-week hospitalization. Tucker certainly had no shortage of visitors after his owners left for the day.



He became very popular with students, nurses, doctors, and support staff.

Beginning Tuesday, September 16, Tucker improved steadily. The tremors subsided, though his muscles remained rigid. Normal function seemed to return to Tucker's tail first, as he would sit in a supportive trough, wagging his tail at everyone passing by. He would intermittently try to move out of the trough, which amounted to little more than thrusting himself out of it onto the floor into an unnatural

position. His jaw finally relaxed, and he began to flex and even move his limbs. Tucker was then placed in an orthopedic sling. This allowed him to bear weight and move his limbs, until one day when he was discovered at



the other end of the hallway, having moved the sling with him. After a seemingly interminable period of unrelenting illness, Tucker had suddenly begun to improve dramatically every day. "During this recovery period, I couldn't wait to come to the hospital each day to see what Tucker could do. The Golds and I would spend each visit marveling at the slightest improvement," says Bentley.

Radiographs on September 22 showed that the pneumonia had resolved. Tucker was eating and drinking on his own and even was taken outside for brief walks. During this time, the inquisitive nature Tucker's owners had often spoken of returned. Now able to walk, Tucker would sample cotton balls, tape, and everything else he could find. He left the hospital on Thursday, September 25 to continue his recovery at home.

"His prognosis at this point is excellent," says Bentley. "I saw him recently, and he is gaining weight, and his legs are straightening out. His face has finally relaxed so that he has the droopy expression characteristic of a bullmastiff. We expect that his conformation and musculature will return to normal as he continues to recover."

## Tetanus

*Clostridium tetani* is an anaerobic bacterium that is widely distributed in the soil. *C. tetani* usually enters the body through a wound, and in anaerobic conditions the spores germinate and produce toxin. The toxin usually spreads by traveling along peripheral nerves to the spinal cord, but can also spread through the body via the blood. The toxin acts on the central nervous system by interfering with the release of inhibitory neurotransmitters. Muscles contract and become spastic, and affected animals are particularly sensitive to stimulation.

The incubation period for tetanus varies from three to 21 days, although clinical signs usually are seen within five to 10 days of infection. The initial signs typically reflect the location of the source of infection. Localized tetanus, such as rigidity of one leg, is more common than generalized tetanus in dogs and cats due to their relative resistance. Involvement of the facial muscles typically manifests as inability to open the jaw (trismus; a.k.a. "lockjaw") with lips drawn back (risus sardonicus), and erect ears. Diagnosis is usually based on finding a wound in the presence of typical signs. In addition to identifying and removing the source of infection, treatment includes antitoxin, antibiotics effective against *C. tetani* such as penicillin and metronidazole, sedatives and muscle relaxants, and supportive care.

Most dogs with localized tetanus or generalized tetanus without respiratory compromise recover if given enough time and supportive care. The prognosis usually is guarded-to-poor in dogs with generalized tetanus and respiratory complications. Recovery from tetanus does not provide future protection against the disease, and vaccination for dogs is neither available nor recommended.

Although the disease is rare in dogs, dog owners should seek veterinary attention for any wounds noticed on their animals. Although humans are susceptible to tetanus, it is not considered contagious from an affected animal since a wound is necessary for incubation of the bacteria. Exposed people should consult their physicians for specific recommendations.