Bug of the Month: Clostridium

We recently began to explore the genus of bacteria known as Clostridium. Bacteria in this genus are rod shaped, gram positive, and form endospores. Clostridia are found in anaerobic habitats such as soil, aquatic sediments and the intestinal tracts of humans and animals. They usually do not grow under aerobic conditions. Because they release potent toxins and form spores which can persist in the environment for long periods of time, some Clostridia have serious consequences for humans. Over the last few months, we have looked at the species of Clostridia that may have an impact in our work environments, C. difficile, C. perfringens, and today C. tetani.

Clostridium tetani is the third species of organisms within this genus we will explore.

In this photograph from the CDC public image library note the drumstick shape of the organism with the endospores.

This organism is responsible for the disease we know as tetanus. The incidence of tetanus has decreased dramatically since 1940 when tetanus toxoid containing vaccines became widely used. Improved wound management, and sanitary birth conditions have also contributed to the decreased incidence. Between 2001 and 2008 in the United States, there were 233 cases of tetanus reported. Because tetanus is now relatively rare, most health care providers have not seen a case of tetanus.

The C. tetani spores are widely distributed in soil and the intestinal tracts of animals and humans. When the spores enter the body, usually through a break in the skin, under low oxygen conditions, the spores germinate and the bacteria reproduce. C. tetani produces a potent toxin known as tetanospasmin. This toxin is one of the most potent toxins known, the minimum lethal dose for a 70 Kg human is 175 nanograms (a nanogram is one billionth of a gram) The toxin is spread by the blood stream and lymphatics and acts within the nervous system, in the spinal cord, brain, the sympathetic nervous system and in peripheral motor end plates. The result is unopposed muscle contraction and spasm. The patient may have seizures and autonomic disturbance.
Tetanus is an infectious disease but it is not communicable between persons.

The incubation period varies between 3 and 21 days. A short incubation period is associated with more severe illness and with death. The most common form of tetanus is generalized tetanus but localized and cephalic tetanus can occur. Symptoms of generalized tetanus usually begin with stiff jaw and neck and difficulty swallowing. The symptoms progress in a downward pattern so rigidity of abdominal muscles and severe muscle spasms occur. The spasms may occur frequently and may last for several minutes. The spasms continue to occur for 3 to 4 weeks.

Complications include laryngospasm and spasm of the respiratory muscles that interferes with respiration, fractures of vertebra and long bones associated with prolonged muscle spasm and seizures, hyperactivity of the autonomic nervous system with hypertension, and disturbed heart rhythms. Prolonged hospitalization increases the risk of a healthcare associated infection such as pneumonia, sepsis from indwelling devices. Aspiration pneumonia is also a complication.

The average case fatality rate is about 11% however the rate is higher in persons over 60-65 years of age, persons with diabetes, injection drug users and persons who are unvaccinated or have received fewer than 3 doses of tetanus toxoid containing vaccine.

Management of Tetanus includes appropriate wound management with removal of foreign debris and necrotic tissue. Tetanus immune globulin should be given to persons with tetanus. If spasms occur, supportive therapy such as IV fluids, ventilator support may be needed. Antibiotics, and muscle relaxants may be administered, and neuro-muscular blocking agents may be required. Tetanus immune globulin can neutralize only the toxin that is unbound but not the toxin bound to nerve cells. The patient should also be given tetanus toxoid immunization because the minute amount of the extremely potent toxin necessary to cause the disease symptoms isn’t sufficient to stimulate immunity. Tetanus toxoid and tetanus immune globulin should be administered at separate body sites and should never be mixed in the same syringe.

Diagnosis cannot be made using laboratory findings. Cultures of the wound often do not yield *C. tetani* and the clostridia can be found in persons who do not have tetanus. The diagnosis is made based clinical findings.

Tetanus is not transmitted from person to person. Transmission is mostly by contaminated wounds. The wound may be apparent or unapparent, a major wound or a minor wound. Tetanus can also occur after elective surgery, burns, puncture wounds, crushing wounds, otitis media, dental abscesses or infection, animal bites, pregnancy, or abortion. Tetanus has also occurred after self-piercing or self-tattooing.
Neonatal tetanus occurs in newborn infants who have not received passive antibodies from their mother before birth. This occurs when the mother lacks antibodies due to being unvaccinated or inadequately vaccinated. The point of entry is usually the umbilical stump and risk is increased in these infants if the cord is cut by unsanitary means or with unsanitary cord management. Neonatal tetanus is extremely rare in the United States but is common in some areas of the world. Women of childbearing age should receive appropriate vaccination for tetanus.

Tetanus is largely preventable by an appropriate primary vaccination series followed by booster immunization at the recommended intervals. Adults require a booster vaccination at least every 10 years and sooner if needed for wound management. Wound management and prophylaxis is also important for prevention.

About 30% of persons with wounds present for medical care and of those persons, in excess of 50% who meet criteria for prophylaxis do not receive tetanus toxoid or tetanus immune globulin. This may be due in part to the perception that a relatively minor wound does not present a risk.

Older persons have decreased levels of protective antibody because they may not have received booster vaccines at recommended intervals. Declining vaccination coverage with age has been shown with only about 50% coverage in persons over 65. Persons who inject drugs are at increased risk due to unsterile injection techniques, contamination and adulteration of drugs, and lack of immunization. The majority of tetanus in children under 15 years of age (except neonatal tetanus) has occurred in children who were unvaccinated due to religious or philosophical objections.

It is obvious there are many missed vaccination opportunities. Vaccine status should be evaluated during health care visits. In the absence of contra-indications, all persons should receive the primary vaccination series and also receive booster vaccinations at the recommended intervals to maintain antibody protection against this serious disease.

Patients with tetanus symptoms should receive prompt evaluation, timely treatment is essential. Tetanus is not contagious between persons; standard precautions should be used when giving care to all patients.

Vaccine preparations, contraindications, precautions, and schedules are beyond the scope of this article. For additional information about vaccination preparations their use and schedules:
Recommended immunization schedule for children, adolescents, and adults
http://www.cdc.gov/vaccines/recs/schedules/default.htm

CDC Epidemiology and Prevention of Vaccine Preventable Diseases
http://www.cdc.gov/vaccines/pubs/pinkbook/index.html#chapters
Chapter about tetanus is found in this publication

Resources used in preparation of this article:

CDC Epidemiology and Prevention of Vaccine Preventable Diseases
http://www.cdc.gov/vaccines/pubs/pinkbook/index.html#chapters

CDC Tetanus Surveillance United States 1995-1997
http://www.cdc.gov/mmwr/preview/mmwrhtml/00053713.htm

CDC Tetanus Surveillance United States 1998-2000
http://www.cdc.gov/mmwr/preview/mmwrhtml/ss5203a1.htm

CDC Tetanus Surveillance United States 2001-2008
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6012a1.htm