Rabies
By Sarah C. Rivera

Etiologic Agent:
As a current veterinary technician, rabies is a word spoken all too often and without thinking twice. The clinic where I work is an approved rabies quarantine location and dogs are left for a period of 10 days after the biting incident to be observed for any potential rabies symptoms. Rabies is a disease caused by a virus that falls in the Mononegavirales order and belongs to the genus Lyssavirus which are classified for being RNA viruses. Viruses like rabies that have a bullet shape to them and are grouped into the Rhabdoviridae family. The rabies virus attacks the central nervous system and lives in the spinal fluid, saliva or the brain tissue of an infected mammal. The virus causes encephalomyelitis which can lead to death. (1)

Transmission:
According to the CDC the main form of transmission occurs through a bite of an infected animal. Although all mammals can become infected with rabies, there are a handful that are our main culprits. A person may also become infected when coming in contact with the saliva of an infected animal when it gets into their eyes, a cut, nose or mouth. The latter is a very rare form of transmission. Being outside or in constant contact with animals while having scratches or open wounds puts a person at higher risk of transmission. Organ transplants are also a form of transmission but are more rare than coming into contact with the saliva by chance. (1)

Reservoirs:
Mammals are the only source of rabies, non mammals are not susceptible to the virus. With that being said, there is a certain population of animals that are our typical reservoirs and have shown different variants of the virus. These animals are the fox, raccoon, skunks and coyotes. If our pets come into contact with these animals they may also contract rabies, therefore, cats and dogs are also on the list of reservoirs. According to Merck though, all of the reservoirs mentioned above are vectors of the rabies virus but not all vectors are reservoirs. In Texas, coyotes, raccoons and bats are amongst the most typical offenders. At the clinic we have seen multiple coyote attacks as well as contact with bats. Being the home of the largest urban bat colony, Austinites must be careful with what their cats bring into the house or what is lounging in the attic. (4)
**Characteristics of Microorganism:**

The rabies virus is bullet shaped and is made up on an envelope with about 400 projections that resemble spikes. Inside you can find a single helical strand of negative RNA and there are several strains of the virus which adapt to their specific host. The spikes are made up of glycoprotein and the envelope is composed of M protein. The RNA encodes for five to six proteins. (1) (5)

[Image of virus structure]

http://www.cdc.gov/rabies/transmission/virus.html

**Identification:**

In animals, testing for rabies is not an easy procedure as they have to be humanely euthanized first. After, samples of their brain will be sent off to the state laboratory where testing will be performed per CDC rules and regulations. The two important sections of the brain are the brainstem and the cerebellum. In the direct fluorescent antibody test they are searching for the rabies virus antigen in the tissue of the infected animal. The antibody which is fluorescent will be incubated with the brain tissue and if the animal indeed had rabies, the antibody will bind to the antigen. If the animal was not rabid, there will be no staining. Another test that is not considered a diagnostic for rabies is the viewing of histology. The CDC also utilizes immunohistochemistry which provide a way to diagnose rabies in tissues that have been fixed in formalin. This method is more sensitive than the one stated previously and it utilizes antibodies to look for inclusions of the rabies virus. Electron microscopes can let us observed the actual detail of the virus and its bullet shaped body. Lastly, the CDC can amplify the nucleic portions of the virus by using reverse transcriptase to copy the RNA into a DNA molecule. Then the polymerase chain reaction is used to amplify the DNA. When they have human saliva or skin biopsies this is a great test to run which helps back up the result from the direct fluorescent antibody test. (1)

**Symptoms of Disease:**
It is easy to confuse the first set of symptoms with those of the common cold or flu as they involve malaise, headache, lethargy and fever. The bite area may be uncomfortable and tingly. In the next few days as the virus makes its way the person may develop anxiety, agitation and confusion along with some cerebral dysfunction. Other symptoms seen before the acute period of illness are hallucinations and insomnia. Rabies is a dangerous disease because it infects the central nervous system which is composed partly by the brain, our control unit. As soon as the clinical signs of rabies develop the person has an extremely low probability of survival and any kind of treatment is just to keep them comfortable. According to the CDC there has been less than 10 cases documented where a human has survived rabies.

In humans there is multiple tests that are completed before they succumb to the virus. A person must supply samples of serum, spinal fluid, skin, hair follicles and saliva. These will be tested by reverse transcriptase and then PCR and the spinal fluid and serum will be good samples to look for antibodies. (1) (2)

**Historical Information:**
Rabies was recorded as early as 2300 BC in the Eshnunna a Babylonian city. Aristotle also wrote about it in 400 BC describing dogs as being crazy and infectious to others they bit. The word rabies comes from the Latin word that means madness or rage. (6)

**Virulence Factors:**
Initial infection occurs when the envelope on the rabies virus attaches to the host cell by the process of adsorption. The G protein binds easily to neural cells, which is why this virus is said to be neurotropic. It attacks the CNS via the PNS after it enters the host and its cytoplasm. Uncoating of the virus the occurs which makes transcription and translation easy. The finished product of virions will release from the host cell after assembly and replication. (1) (5)

**Control and Treatment:**
Because we are fully aware of the toll the rabies virus can take on human and animal lives, there are plenty of guidelines in order. Pets that have come into contact with a rabid animal must follow a specific protocol set up by the city, state or nation. In Austin, the bite or animal who has been exposed, must be quarantined for a minimum of 10 days. If after these 10 days there are no signs of the virus, the pet is free to go home and will be vaccinated again. Educating our public on the importance of the rabies vaccine is also a way to control the number of exposures. By law, people in the state of Texas have to vaccinate their pet every 3 years at
the very minimum. In our office, we ask that the owners vaccinate yearly to make sure there is sufficient immunity. Euthanasia of rabid animals is extremely necessary in cases where the subject is infected. Animals that are infected have zero probability of survival. Humans must be vaccinated as soon as possible to give them the best chance of survival. The handful of people that have survived worldwide, have done so through an induced coma while the majority of those infected die within days. (12) (9)

Vaccine Information:
Rabies is a preventable disease. The important things to remember are to keep your pets vaccinated against rabies just in case they happen to come into contact with a rabid animal. This will also limit your exposure to the virus. Veterinarians, technicians and people who work with rabid tissue should receive a pre-exposure vaccine. The vaccine is made from a killed rabies virus and can also help those that have been exposed as long as it is administered in a timely manner. According to the vaccines website hosted by the government, the pre-exposure vaccine is given in 3 doses. The timeline is as follows: dose 1, dose 2 is given 7 days after dose 1 and dose 3 is given 21 or 28 days after dose 1. If your lifelong career exposes you to the virus from time to time, it is best to always get boosters and check for immunity often. Those that have been bitten and have never had the vaccine should receive four doses of the vaccine. The first dose is administered as soon as possible, and the other three doses on the third day after the first dose, seventh and fourteenth day after. (11) The next injection will be the Rabies Immune Globulin which is given along with the first dose of the last set. If the person has been vaccinated before, they will not need the Rabies Immune Globulin and only two doses of the rabies vaccine. The rabies immune globulin provides your body with the antibodies it will need to fight the rabies virus. (7)

You can prevent infection by making sure your dogs are inside at night or not in a heavily wooded area where wildlife is likely to sleep. Cats are also known for bringing presents to their owners through the kitty door. Vaccination is extremely important for indoor/outdoor pets.

Local Cases:
In 2013 in Travis County 89 bats tested positive for rabies. This year from January to September the number is at 70. The following chart indicates that between 2008 - 2009, we had 594 rabies cases in cats and 156 rabies cases in dogs. (8)
Global Cases:
Per the Global Alliance for Rabies control, one person dies from this disease every 10 minutes. About 60% of the people are under the age of 15 and 95% of them reside in Asia or Africa. In September of this year, China euthanized 5,000 dogs after 5 people died from the rabies virus. The map below illustrates the countries that are at high risk of rabies in red. (10)

References:
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