

E. coli

I. Introduction.

An odd disease, since it's only a few strains that are harmful. The rest live with us quite nicely, and most people have *E. coli* bacteria living in their gut.

It's only when they either get out of the gut or you get a nasty strain that problems arise.

II. Cause & spread.

A bacterium. Scientific name is *Escherichia coli*. It is gram negative, anaerobic (facultative, meaning it can tolerate oxygen), and rod shaped.

- Some strains have flagella to help them move, others do not.

The problem is that there are many different strains of this bacteria.

- Most, as mentioned, are fairly harmless and live in our guts. Most infants are infected within a few days of birth, and will then harbor *E. coli*.
 - They live in the large intestine, and help us digest food (so are really helpful).
 - It is possible (through transfer of genetic material) for these to become suddenly nasty (virulent).
- However, some strains will release nasty toxins that can cause diarrhea, kidney problems, or worse.
 - These strains can be picked up from unsafe food (and there's a large selection of foods that can be unsafe!)
 - Unwashed vegetables (e.g. spinach) or unsafe meat handling practices are primary culprits.
 - Note that other animals can tolerate some of these nasty strains.
- Generally, *E. coli* spreads through the fecal-oral route (amazing how effective that is!)
 - Manure from infected animals is spread on fields
 - Crops can be contaminated with water used for irrigation (depending on the source of this water).
 - Obviously if animals are not slaughtered carefully, the meat can be contaminated with the contents of the intestine.

III. Infection.

- What makes some strains so dangerous?
 - As usual, with bacteria, toxins are released.
 - In this case, some strains, particularly O157:H7 make dangerous toxins that are released into the gut.
 - The “O” and “H” refer to various antigens found either the cell wall (“O”) of the bacteria or on the flagella “H” of the bacteria.
 - some of these toxins are similar to those released by cholera.
 - toxins are both absorbed by intestinal cells AND prevent cells from absorbing water (diarrhea).
 - there are other dangerous strains, but O157:H7 is probably the best known:
 - it was the strain that caused all the ruckus in spinach a few years back.
 - *E. coli* can cause massive damage if it can get out of the intestine (through a sore, rupture, ulcer, etc.).
 - Peritonitis (inflammation of the peritoneal membranes) can cause death.
 - *E. coli* can also cause inflammation of the urethra & bladder.
 - This is about 14 times more common in women (easier for bacteria to get to the opening of the urethra).

IV. Symptoms, etc.

- Incubation period is about 7 days.
- Symptoms include:
 - severe abdominal cramps
 - watery diarrhea
 - bloody stools (caused by sores/infections in the intestine)
 - Sometimes:
 - mild fever/nausea/vomiting
 - In serious cases:
 - toxins can enter blood stream and start to destroy red blood cells and platelets.
 - this leads to anemia & bleeding,
 - eventually kidney failure.

- Usually, symptoms clear up without too much treatment in 5 - 10 days.

V. Treatment.

Varies. Antibiotics are quite effective, though *E. coli* (like many other bacteria) is rapidly acquiring resistance to numerous different antibiotics.

- A recent study shows that *E. coli* is acquiring “adaptive mutations” about 1000 times faster than previously thought.

Other treatments are supportive:

- maintaining salt & water levels (to counter diarrhea), blood transfusions, in extreme cases dialysis.

Phage treatment:

- For years, the Soviet Union was working on phage treatments:
 - this consists of viruses that can infect dangerous bacteria.
 - they also developed a strain to deal with *E. coli*.
 - This was not available in the U.S., though recently the FDA did approve a phage for *E. coli* for use on live animals destined for slaughter.

VI. Miscellaneous.

- *E. coli* has been responsible for numerous food poisonings in the U.S., and causes lots of problems:

- Spinach (October 2006):
 - 199 people infected, 3 deaths.
 - caused by infected packages of spinach, all processed at the same place on the same day.
- Taco Bell (November - December 2006)
 - 71 people infected
 - not clear what food caused it, though it was mostly in the mid-Atlantic area.
- Ground beef patties (also in October) 2006
 - about 40 cases, mostly in the northeast, but also in Florida.

Salmonella (these days some folks are trying to rename it to Salmonellosis).

I. Introduction.

Let's stay with gut disease for the moment.

We've all heard about the “dangers” of raw eggs, or undercooked meats. Even reptiles (pet turtles, lizards) have been implicated in salmonella. Let's figure some of this out.

II. Cause & spread.

Surprise - same bacteria as causes typhoid (as we've discussed). Gram-negative, rod-shaped, has flagella. Different strain (this particular bacterium has numerous different strains).

Salmonella is named after Daniel Salmon, who first discovered the bacterium (with lots of help from Theobald Smith).

Bacteria has to be consumed.

Salmonella is usually caught by eating (or handling) something that's infected with Salmonella.

Some common sources:

- raw eggs
- raw meats (chicken, beef)
- fruits (unwashed).
- occasionally, foods can become contaminated through indirect contact with infected foods (e.g., surfaces).

Salmonella can occur in the intestine of other animals (& humans) which is why it's usually associated with undercooked meats.

It's also found quite often on reptiles, which is one reason to always wash your hands after handling turtles, lizards, snakes, etc.

Pretty much anything that can harbor the bacteria can serve as a source of infection, including water.

III. Symptoms.

Salmonella has an incubation period of about 3 - 6 days.

It is thought that it's the response to the bacteria that causes most of the symptoms (not so much the toxins).

- Symptoms include

- intestinal:

- nausea/vomiting/abdominal cramps/bloody diarrhea

- other:

- headache, fatigue, rash

- occasionally arthritis (usually disappears after months/year, but occasionally can progress to permanent arthritis).

- In rare cases, the bacteria can enter the rest of the body and cause much more massive problems.

- Usually the disease clears up by itself in 5 - 7 days.

IV. Treatments.

Although it can make you rather sick, usually no treatment is needed. But in more serious cases, we can talk about:

- Supportive: rehydration (intravenously) to counteract the diarrhea.

- Also, we have antibiotics.

- these are usually only needed if the bacteria spreads out of the intestine.

- The problem (as usual) is antibiotic resistance, and we have strains that are resistant to multiple antibiotics (not really surprising, since this is the same species of bacteria that causes typhoid).

There is no vaccine available (not sure one is really needed).

IV. Miscellaneous.

Salmonella does kill people.

- each year 1.4 million people in the U.S. catch Salmonella.

- it kills a little over 500 people each year.

- about 2% of these cases progress to arthritis.

Bioterrorism.

- This disease is NOT going to kill a lot of people, but it's notorious because it has been used to make people sick.

- In 1984, 751 people came down with Salmonella in Dallas, Oregon.
 - Salad bars at ten restaurants were contaminated with salmonella.
 - the idea was to try to make people too sick to vote, so that the followers of a sect (led by Bhagwan Shree Rajneesh) would win the local elections.
 - fortunately there were no fatalities.
 - two people were eventually prosecuted and jailed for 29 months.
 - lots more details are available on the web for those who are interested.

Rabies

I. Introduction.

A disease known since ancient times. It's described in Mesopotamia, China, Greece, Rome, India and elsewhere.

The name is Latin for "fury or rage" (one source claims a Sanskrit origin, but that seems unlikely).

- In the first century a Roman by the name of Celsus recommended immediately removing any bitten tissue and cauterizing the wound with a hot iron.
- This advice was repeated as late as 1812.
 - but it might have worked.....

Generally, until recently there wasn't much anyone could do about rabies. If you got bitten by a rabid animal, you died.

- Rabies is 100% fatal if symptoms start (but see below).

II. Cause & spread.

A Lyssavirus (a RNA virus).

- The virus infects the nervous system and travels to the brain where it starts to do its damage.
- It is generally spread through the saliva of an infected animal (mammal). The animal bites another animal, and introduces the virus into the body.

III. Symptoms.

Pretty nasty. Once symptoms start, there is nothing that can be done.

Incubation period is usually 2 - 12 weeks, though there are records of an incubation period of 2 years.

Symptoms start out (typically) as flu like:

- fever/chills/fatigue/muscle aches
- sometimes tingling or itching at the site of the bite

They then progress

- slight or partial paralysis
- anxiety
- insomnia
- confusion/agitation
- abnormal behavior/paranoia/terror/hallucinations/delirium

Large amounts of saliva and tears are produced (saliva, in particular, is filled with viruses).

The throat and jaw slowly become paralyzed, making it extremely difficult to swallow.

- patients presented with water “panic” due to inability to drink (painful) and/or because they are extremely thirsty.
- because they can not swallow, saliva overflows mouth (“foaming at the mouth”). Rabies also causes excess saliva production.
- disease is also known as hydrophobia (“being scared of water”).

Death follows 2 - 10 days after the first symptoms.

- A few “survivors” were left with severe brain damage.
- With one exception (see below).

Descriptions are terrifying (here, a 23 year old woman):

"On June 17, 1981 she was bitten on the ankle by a dog in New Delhi. On August 18, about two months later, she experienced the first prodromal symptoms. She became anxious and depressed, and it became impossible for her to drink more than small sips of liquid. While sleeping, she frequently sat up in bed suddenly, terrified. On August 19, she became confused, hallucinated, and was incontinent of urine. On August 20, she was unable to eat or drink and was taken to the hospital where she hallucinated and screamed in terror. Misdiagnosed as a psychiatric case, she was injected with a tranquilizer and sent home, however she repeatedly woke up screaming in fear and became so wild and agitated that her husband felt he could not deal with her by himself and took her to her mother's house. She remained terrified, hallucinating and screaming in horror throughout the night. She had no water for almost three days. She fell into a coma the next morning,

and died on August 23."

Treatment & prevention:

The good news is that there is a vaccine, and it's better than the original vaccine developed by Louis Pasteur:

- his original vaccine used dead (infected) rabbits. The virus was weakened by letting it dry.
- it worked, and for the first time there was something that could be done about rabies.
- the vaccine **MUST** be administered as soon as possible, and definitely before symptoms start (this is true also for the more recent vaccine).

These days we use a "human diploid cell" vaccine. It uses an attenuated virus

- Recently this has been improved even further.

One problem with rabies is that it's on the wrong side of the blood - brain barrier, which makes it hard to get any anti-viral cells to the infection.

Other suggestions are washing the wound with soap and water (water kill the virus).

In addition to the vaccine, rabies immunoglobulin is injected.

- note - five doses of the vaccine are needed over 28 days.
- with the old vaccine it was 14 doses injected into the abdomen (with a large needle!)

The vaccine works because it takes time for the virus to get to the brain and/or spinal cord.

Of course, one can also get vaccinated ahead of time:

- dogs and cats are required to get vaccinated.
- people can get a vaccine as well, and it's sometimes recommended if traveling to areas where rabies is common (e.g. India).
 - health workers, veterinarians, and some others with high risk of contact will get the vaccine.
- still, even with a "pre-exposure" vaccination, one needs to get follow-up vaccinations (these are not nearly as extensive as for anyone else).

Recently a lot of progress has been made in vaccinating wildlife.

- A vaccine can be put into "bait" and distributed. Wild animals will eat the bait and become vaccinated.

- This has been extremely effective in Europe, where rabies in wildlife has been reduced considerably.

- They're trying it here, with some success, but we've got a long way to go.

Other treatments:

There aren't any, with one exception:

- In 2005, a 15 year old girl survived rabies. She was placed in an induced coma, and then provided with antivirals and other treatments.

- She was isolated for 31 days and hospitalized for 76 days. She has now recovered virtually completely, though it took a long time.

- Since then a few more attempts have been made using this approach:

 - they haven't worked.

 - however, the physician in charge says that his protocol wasn't followed exactly in the other cases.

- we may finally be on the track to something that works, though obviously we need to do more research:

 - how and why it worked need to be explored

 - and obviously, a better, easier to follow, protocol that works in most cases would be nice.

Incidence & miscellaneous:

Unfortunately, rabies is a long way from disappearing.

It's endemic in the U.S., particularly in the eastern part. Raccoons, in particular, have been suffering through an outbreak since the 1970's.

- Every year the county (Fairfax) finds numerous rabid raccoons in our area.

- Raccoons transmit the disease to other animals (foxes, feral dogs, cats, etc.)

Elsewhere other animals act as reservoirs.

- Skunks in the Midwest

- Feral dogs in India, Africa

Bats also harbor the disease

- There is some question as whether or not rabies kills bats everytime.
 - There is some evidence that some bats may survive rabies.
 - Regardless, it does make them sick, and they can behave abnormally.
 - Bat bites are probably the main source of human rabies in the U.S., mostly because they may not be noticed (they can be almost painless).
 - PLEASE, note that the vast majority of bats do not have rabies.
 - bats are an incredibly useful - and fascinating - part of our wildlife.
 - A small number do get rabies and can then spread it.
 - if you see bats in the daytime, or behaving erratically, then you should be careful.
 - As an aside, I could talk about bats for hours.....

It is also possible to get rabies through organ transplants:

- A number of cases have been traced to people getting organs from donors who died of unknown causes.
 - Corneas, livers, kidneys, etc. have all been implicated
 - Some time after getting the organs, the recipients develop rabies.

Rabies is a worldwide problem, though there are some areas that don't have rabies:

- Australia, Great Britain (though it is found in bats), Japan, some Scandinavian countries.
- Unfortunately, it kills a number of people every year.
 - Annual death toll is estimated to be close to 30,000
 - Only a few people (usually 1 - 2) in the U.S. die of rabies each year.

HPV (Human Papilloma virus)

I. Introduction.

HPV is the most common sexually transmitted disease.

- fortunately it “usually” doesn't do all that much.
- but it in those few instances when it does act up, the consequences can be deadly.
- of course, it's also been in the news recently due to a new vaccine.

II. Cause & transmission.

- Any of over 100 different viruses. All of them are DNA viruses.
- Of these, about 30 - 40 are transmitted through sexual contact.
- We “think” that HPV spreads through small abrasions in the skin.
 - Once this happens, it infects epithelial cells (i.e., skin cells).
 - At this point it can start to do its damage (if any).

III. Symptoms.

- It has a latency (or incubation) period of anything from months to years.
 - During this time the a person can be infectious.
- It can then to cause a number of different (but related) problems:
 - Warts, in a number of different areas, including the genitals
 - scaly skin
 - oral infections (whitish looking areas in mouth)
 - various cancers.
- It's the last one that is most serious.
- Many of the other symptoms do not cause serious problems and often will go away on their own.
 - sometimes they can be recurring (go away for a bit, then come back).
- The cancers can be of several types:

- mouth/throat/anus/vagina/penis (these may have other causes as well)
- most serious, though, is cervical cancer. It is also far more common than the others
- Cervical cancer usually takes quite some time to develop, and it appears that it implies that one has HPV for most of this time (i.e., a persistent infection).

IV. Treatment.

- There is no good treatment for the virus.
- Usually, the immune system can take care of HPV, and the problem(s) resolve on their own.
- There are several things that can prevent HPV:
 - Condoms offer some protection, but since the virus can spread through skin-skin contact this is not full protection.
 - More recently, there's been a vaccine that can protect against 4 types of HPV, in particular those strains that cause the most cervical cancer (and warts).
 - Currently the vaccine is only offered to women. Safety of the vaccine in men hasn't been established.
 - other things help as well such as reducing the number of sexual partners
 - but even this isn't fool proof.
 - Diet appears to help a little - lots of fruits and vegetables, as well as vitamins all seem to have an impact on HPV, though the exact extent seems unknown.
- There are also tests for cervical cancer and such (pap smears).
 - As usual, if detected early, treatment is much more effective.
 - This is also recommended for some high risk groups of men (gay men have a higher risk of anal cancer).

V. Miscellaneous.

HPV is incredibly common. Estimates are:

- 20 million Americans are infected at any one time.
- Each year 6.2 million people become infected.
- About 1% of the population have genital warts
- 11,000 women are diagnosed with cervical cancer each year (3,700 women die)

21 states introduced legislation that would require girls to be vaccinated.

- of course, this has raised the usual controversies:

- is this promoting sexual promiscuity? Should this be required?

- it also requires 3 shots.

Incidentally, the link between cervical cancer and HPV was first discovered in prostitutes, which had a much higher risk of cervical cancer.