M220 Lecture 25

Factors Responsible for Transforming Normal Cells to Cancer Cells (continued)

7. Viruses (continued) - In 1962 human adenovirus which caused upper respiratory infections in humans was injected into hamsters. Hamsters would get cancer. Perhaps this represented another situation where the consequences of viral infection in the wrong host produced cancer. In the 1960’s Bittner’s mouse mammary tumor virus was isolated and shown to cause breast cancer in pregnant and lactating mice. This same virus when introduced to male mice would also cause breast cancer in these male mice if they were also given female hormones. Cancer was shown to be influenced by the presence of hormones. Incidentally, viruses identical in structure to Bittner’s mouse mammary tumor virus have been observed in human milk. Perhaps there are human implications. We now believe that 20% of all cancers are induced by viruses.

a. Examples of DNA viruses that are oncogenic include: papillomavirus, SV 40 virus, EB virus, hepatitis B virus.

b. Examples of RNA viruses that are oncogenic include: the retroviruses (HIV, HTLV -1, HTLV-2).

Viral Transmission

1. Horizontal transmission-from one member of a species to another member within that species.
2. Vertical transmission-from parent to progeny.
   a. Transovarial-virus from egg to progeny.
   b. Transplacental-virus from mother across the placenta.
   c. Translacteal-virus from mother’s milk to progeny.
   d. Transprostatic-virus is transferred through sperm to progeny.

Cancer is a multiple step or event process. Genetic damage that is not repaired can be maintained in a cell line. Eventually these damaging events within one cell can build up to transform a cell into a cancerous cell. What are some of the viral implications associated with causing damaging events and transforming a cell into a cancerous cell. Perhaps viruses may activate oncogenes by:

1. Triggering gene amplification-gene amplification is a phenomenon where multiple copies of a gene are made. This would allow for the production of abnormal amounts of gene products at abnormal times.
2. Causing translocation-the movement of genes from one location to another which could potentially alter gene expression. Transduction may facilitate this process.
3. Integrating as a provirus into a cells genetic structure might also potentially result in altering gene expression.

An interesting theory called the protovirus (“near virus”) theory mimics to some extent the activity of the provirus. It describes a virus-like pattern that technically does not involve a virus. In the protovirus theory a renegade piece of DNA unexpectedly and without normal instructions initiates transcription. This DNA is transcribed to mRNA. The mRNA then undergoes reverse transcription back to DNA, which
is what would happen in the case of a retrovirus. A complementary strand is then synthesized upon this DNA and the resultant double stranded DNA can now integrate into cellular genetic material. The placement of this segment could be different from its original and normal location and would therefore exist without normal controls. This could possibly result in cell transformation into a cancerous cell.

**Medical Parasitology**

This includes discussions of protozoa, helminths (worms), vectors and medical consequences of these parasites.

The protozoans are unicellular, aerobic and heterotrophic eukaryotes. Asexual reproduction occurs by budding, fission or schizogony. Schizogony is a multiple fission process where the nucleus divides and makes many copies within a single cell. Portions of the cytoplasm will then surround each nucleus. The cell then fragments into many pieces. Sexually, protozoa reproduce by conjugation. Some protozoa can form cysts under adverse conditions. This process of encystment may occur when food, oxygen and water amounts are inappropriate. Improper temperatures and increased levels of toxic chemicals may also trigger this protective process. Encystment will protect the protozoan and allow for survival of the parasite outside of the host. The life cycles of some of these protozoa are quite complex.

The helminths are multicellular eukaryotic worms. They belong to two phyla: Platyhelminthes (flatworms) and Aschelminthes (roundworms). Within the Aschelminthes the class of roundworms known as the Nematodes is where the worms that are human parasites are found. However, relatively few in this large group of Nematodes infect human populations. There are some Nematodes which are considered to be intestinal and some which exist in the tissues (filarial worms). In general, transmission of the helminthic diseases is usually by the gastrointestinal route, but that is not always the case. The worms are complex and possess digestive, circulatory, nervous, excretory and reproductive systems. However, these parasitic worms are likely to have less developed, reduced or incomplete digestive, nervous and locomotion systems. They live in rich body fluids where nutrients are likely to be partially digested and easily accessible. Food is delivered to the worms. They do possess reproductive systems which are quite complex and efficient. The worms are either dioecious (means two houses) or monocious (means one house). Separate male and female worms are considered dioecious. Worms possessing both male and female parts are considered to be monocious (also known as hermaphroditic). In discussing the hosts of these parasites, a definitive host will harbor the sexually mature (adult) worm which is capable of producing eggs. The intermediate host will harbor the immature larval form of the worm.

Some of these parasites are delivered by Arthropod vectors. These are either arachnids or insects. More later.

See Medical Parasitology handout.