

Genetic Basis of Cancer

Chapter 22.2

Cancer

- Disease characterized by uncontrolled cell division.
 - Genetic disease at the cellular level
 - More than 100 kinds of cancer have been identified.
 - Classified by the type of cell that has become cancerous.

Common Characteristics

1. Most originate in a single cell
 - A cancerous growth is considered **clonal** origin, meaning the cancerous cells came from 1 original cell.
2. Usually a multistep process genetically and at the cellular level
 - Precancerous growth = **benign** growth.
3. When cells become cancerous their growth is described as **malignant**.
 - Cancer cells are **invasive**, meaning they can invade healthy tissue .
 - They can also be metastatic meaning they migrate to other parts of the body and cause tumors elsewhere.

Statistics

- In the US, approximately 1 million people are diagnosed with cancer each year.
- $\frac{1}{2}$ of these million will die from the disease.
- In 5-10% of all cases the predisposition to develop cancer is an inherited trait.
- Most cancers, 90-95%, are not passed from parent to offspring.
- At least 80% of all human cancers are related to exposure to agents that promote genetic changes in somatic cells.

Environmental Agents

- = mutagens that alter DNA in a way that affects the function of normal genes.
- If DNA is permanently modified in somatic cells, such changes may be transmitted during cell division.
 - An environmental agent that causes cancer by affecting cell division = **carcinogen**
 - Example : UV light

Oncogenes

= genes that promote cancer.

- To become an oncogene, a proto-oncogene must incur a mutation that causes its expression to be abnormally active.
- **Proto-oncogene** = a normal, non-mutated gene that has potential to become an oncogene.

3 possible effects of a mutation

1. The amount of encoded protein is greatly increased.
2. A change occurs in the structure of the encoded protein that causes it to be overly active.
3. The encoded protein is expressed in a cell type where it is not normally expressed.

Cell growth Signaling Pathways

- Oncogenes commonly encode proteins that function in cell growth signaling pathways.
- *Mutations convert proto-oncogenes into oncogenes.*

Tumor Suppressor Genes

- The role of a tumor suppressor gene is to prevent cancerous growth.
 - * If a tumor-suppressor gene becomes inactive by mutation, it becomes more likely that cancer will occur.

p53 Gene

- The p53 gene is the most commonly altered gene in human cancers.
- About 50% of all human cancers are associated with defects in p53.
 - **the primary role of the p53 gene is to determine if a cell has incurred DNA damage.

Assignment in Small Groups

Pg. 631, "Questions for Student Discussion/Collaboration:

#2 *Our government has finite funds to devote to cancer research. Discuss which aspects of cancer biology you would spend the most money pursuing:*

- A.** Identifying and characterizing oncogenes and tumor-supressor genes.
- B.** Identifying agents in our environment that cause cancer.
- C.** Identifying viruses that cause cancer.
- D.** Devise methods of killing cancer cells in the body.
- E.** Informing the public of the risks involved in exposures to carcinogens.

In the long run, which of these areas would you expect to be the most effective in decreasing mortality due to human cancer?