Broken Genes

The Role of DNA Repair in Cancer

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Outline

• What is cancer and how is DNA involved?
• How does DNA repair work and how do defects cause cancer?
• How does this understanding help us treat cancer?
Outline

• What is cancer and how is DNA involved?
  – How things work when we’re healthy.
  – What is cancer?
  – What defects are the cause of cancer?
  – A couple examples.
  – Where do these defects come from?
- Body
- Organ Systems
- Organs
- Tissues
- Cells
The Life of a Cell

Birth

dead cells must be replaced

“Growing Up”

Work

“Stuff Happens”

Death
Making New Cells

This is what I mean by “GROWTH”!

- Must grow to replace dying cells or to heal
- Must be able to stop growth
Regulating Cell Division

- Normally, cell division is tightly controlled
- Some factors promote growth, others inhibit
- Balance of these factors determines cell fate
Growth Regulators

These are molecules (mostly PROTEINS) inside your cells which control cell division

- These proteins DO NOT come from your diet

X

Rb (retinoblastoma)
p53

Estrogen
Estrogen Receptor

THESE PROTEINS CAN GET MESSED UP
Uncontrolled Growth

Lung Cancer

Normal Lung

- Uncontrolled growth

http://www.flickr.com/photos/pulmonary_pathology/

SITN
Why do people die from cancer?

• Uncontrolled growth causes:
  – Organ failure
  – Direct invasion
  – Tumor byproducts
  – Metastasis
Growth Regulators

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Rb (retinoblastoma)
p53

Estrogen
Estrogen Receptor

THESE PROTEINS CAN GET MESSED UP

• These are molecules (mostly PROTEINS) inside your cells which control cell division
  – These proteins DO NOT come from your diet
Uncontrolled Growth

• Too much gas, too little brake, or both!
  • THIS IS CANCER
Example: Retinoblastoma

- Both familial and non-familial forms
- Childhood retinal tumors (<1 year old)
- High cure rate (90% survive to adulthood)
- Predisposition to various tumors later in life
- Patients usually die from these tumors
Example: Retinoblastoma

- Name of condition and protein

Cell Division
Ex: Chronic Myelogenous Leukemia

• Abbreviated CML
• Cancer of the bone marrow
  – White blood cells
• Most cases are children or young adults
• Recent advances vastly improve treatment
Ex: Chronic Myelogenous Leukemia

CML situation

- ABL Kinase
- Growth Accelerators
- Mutated Kinase (BCR-ABL)
- Activity “flag”

It’s like a lead foot on the gas pedal
Uncontrolled Growth

- In CML there is too much gas!
- THIS RESULTS IN CANCER
Questions?
Where do proteins come from?

How do proteins get messed up?
The Central Dogma

Instructions for making each protein are encoded in DNA as a gene; THE CENTRAL DOGMA of biology.
The Central Dogma

Instructions for making each protein are encoded in DNA as a gene; THE CENTRAL DOGMA of biology
Where do proteins come from?

How do proteins get messed up?
Broken Genes

• If the DNA instructions are messed up, the protein will be messed up too!

ABNORMAL FUNCTION
Uncontrolled Growth
Cancer is a Genetic Disease

• A broken gene (DNA) creates a messed up protein--perhaps a gas pedal that’s always down or non-functional brake

• Cancer does not always come from the parents, but always due to broken genes

• Up next: What is a broken gene and where do they come from? (DNA damage and repair)