Viruses and Cancer

Summer Term
Lecture no. 6

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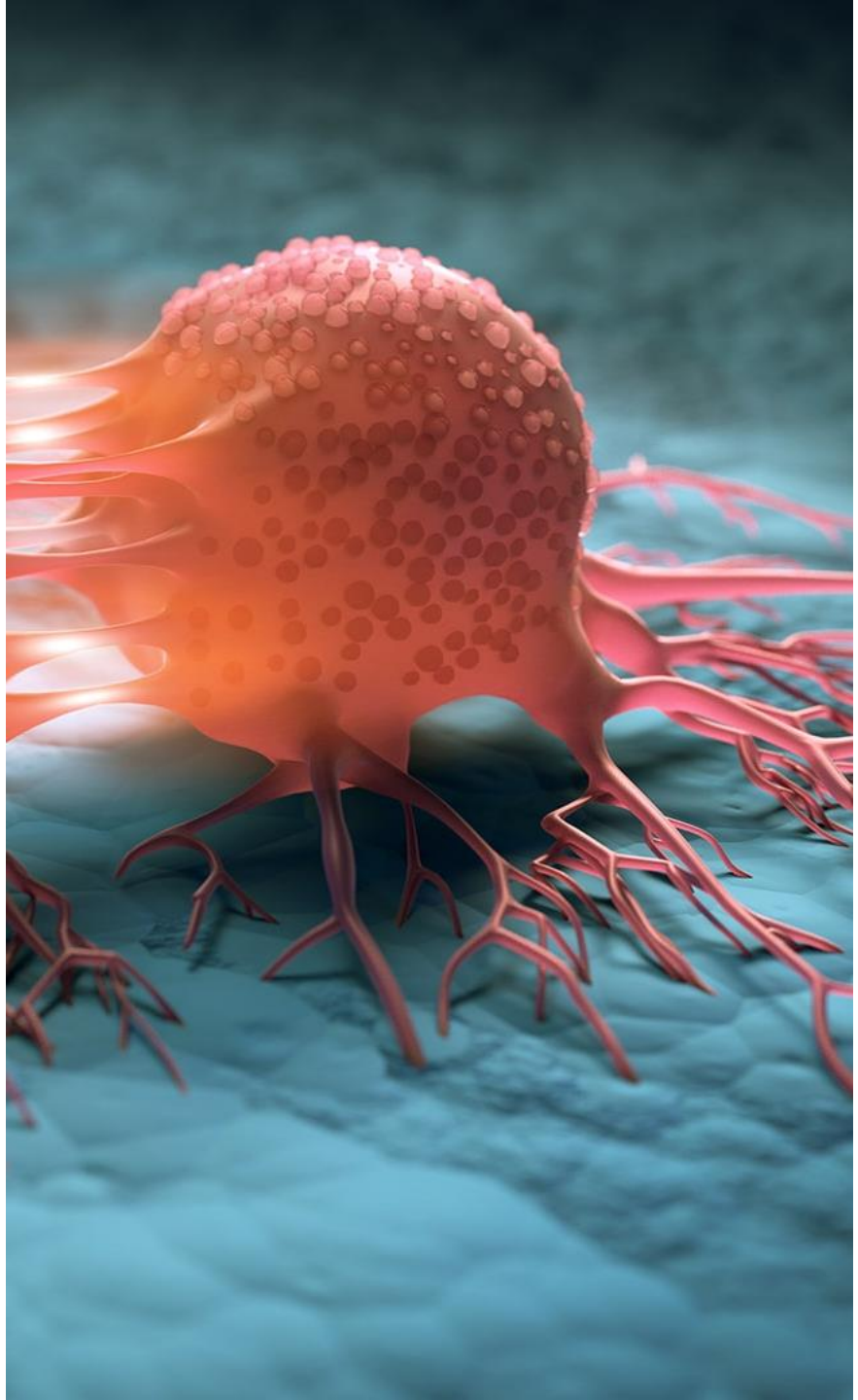
What is Cancer?

- Your body is made of tiny building blocks called cells. Normally, cells grow, divide to make new cells, and die when old or damaged.

- **With cancer**, this normal process breaks down. Damaged cells survive when they should die, and new cells form when your body does not need them. These extra cells can form masses of tissue called tumors.



Factors that Cause Cancer

Many things can **damage cell instructions** (DNA) and lead to cancer. These are called **risk factors**.

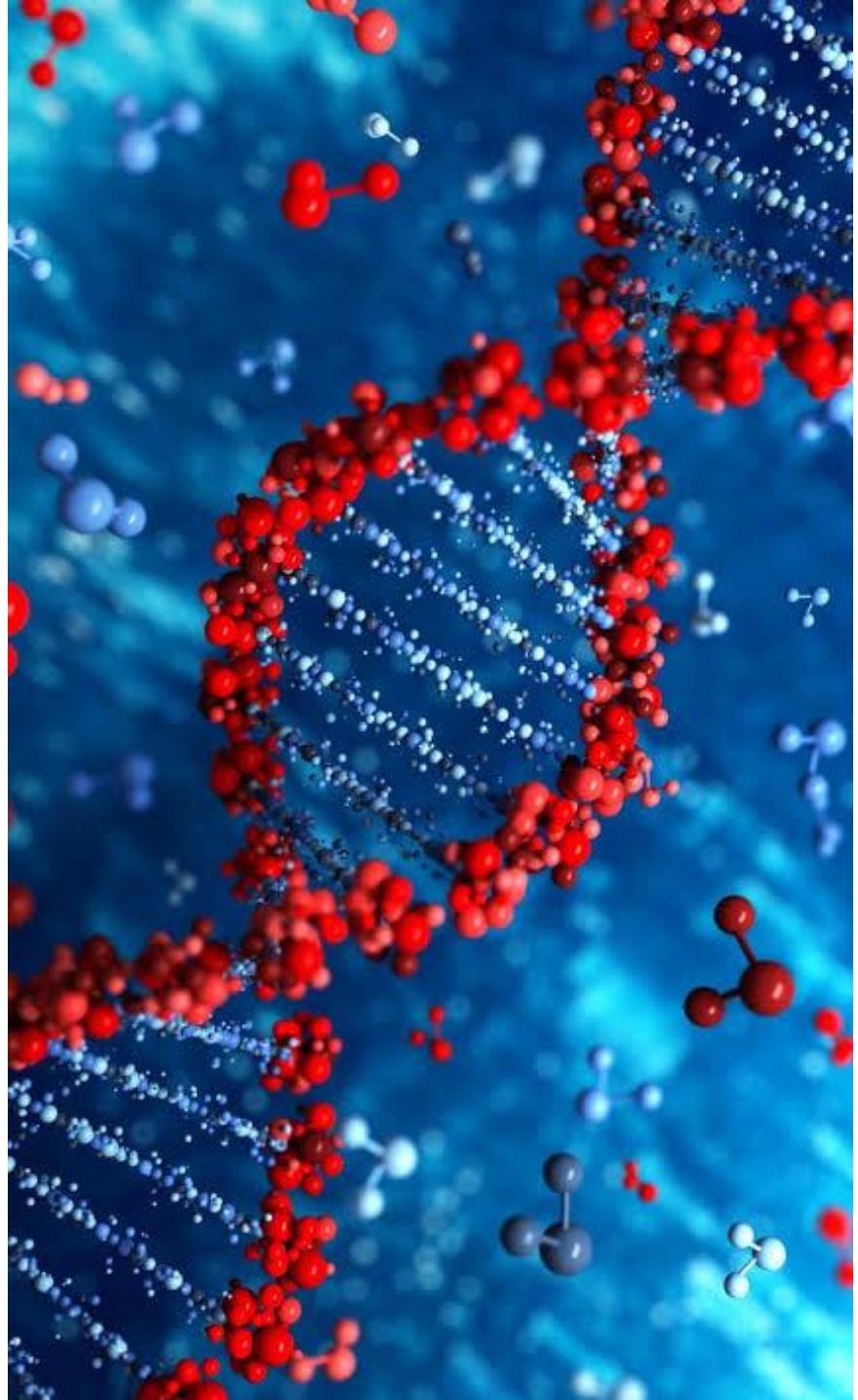
- **Lifestyle choices:** Smoking tobacco, drinking too much alcohol, eating poor foods, and getting too much sun without protection.
- **Family history (Genetics):** Faulty genes passed down from parents to children.
- **Environment:** Breathing polluted air or touching harmful chemicals like asbestos.
- **Age:** Growing older gives cells more time to pick up damage.

- Some viruses can contribute to the development of cancer.
- They usually do this by **infecting cells**, altering normal cell growth, or causing long-term inflammation.
- However, **most viral infections do not lead to cancer**, and cancer typically develops only after years, often **in combination with other risk factors.**

How Viruses are Connected to Cancer

Some viruses can **change the inside of a cell** and cause it to turn into cancer. These are called **oncogenic viruses**.

- **Changing DNA:** A virus enters a healthy cell and puts its own genetic material into the cell's instructions.
- **Stopping cell death:** The viral instructions trick the cell into growing too fast and refusing to die.
- **Causing long-term swelling:** Some viruses cause ongoing damage and inflammation in the body over many years, which helps cancer grow.



How viruses can cause cancer

Viruses may promote cancer by:

1. **Inserting** their genetic material into host cells, **disrupting** normal genes.
2. Producing proteins that interfere [**inhibit**] with tumor-suppressor genes (such as **p53**).
3. Causing **chronic inflammation**, which can damage DNA over time.
4. Weakening the **↓immune system**, making it harder to eliminate abnormal cells.

→ The **TP53 gene [tumor protein p53]** makes a crucial protein (p53) that acts as a tumor suppressor by regulating cell division and destroying cells with damaged DNA.

Virus	Cancers associated with it
▪ Human papillomavirus (HPV)	▪ Cervical cancer, anal cancer, penile cancer, and many throat (oropharyngeal) cancers
▪ Hepatitis B virus (HBV)	▪ Liver cancer (hepatocellular carcinoma)
▪ Hepatitis C virus (HCV)	▪ Liver cancer
▪ Epstein–Barr virus (EBV)	▪ **Burkitt lymphoma**, Hodgkin lymphoma, nasopharyngeal carcinoma, and some stomach cancers
▪ Human T-cell leukemia virus type 1 (HTLV-1)	▪ Adult T-cell leukemia/lymphoma

- **Hodgkin lymphoma** is a type of blood cancer that starts in the lymphatic system, specifically in germ-fighting white blood cells called lymphocytes.
- **Burkitt's lymphoma** is a rare, fast-growing type of non-Hodgkin lymphoma that starts in infection-fighting B-cell white blood cells.

Can viral cancers be prevented?

Yes, in many cases.

- **Vaccination**:
  - The **HPV vaccine** helps prevent most HPV-related cancers.
  - The **Hepatitis B vaccine** reduces the risk of liver cancer.
- **Screening**:
  - Regular cervical cancer screening can detect precancerous changes caused by HPV.
- **Treatment of chronic infections**:
  - Treating hepatitis B or C can lower the risk of liver cancer.
- **Healthy practices**:
  - Safe sex, avoiding shared needles, and maintaining good infection control reduce the risk of viral transmission.

Key points

- About **10–15% of cancers worldwide** are **linked to infections**, with viruses accounting for the majority of these cases.
- Viral infection alone is **usually not enough** to cause cancer. Other **factors such** as genetics, smoking, alcohol use, immune status, and environmental exposures often play important roles.
- Many virus-related cancers are **preventable** through vaccination, screening, and early treatment of chronic infections.

1. When is viral specimen collection generally most likely to provide the highest diagnostic yield?

A. During the late recovery phase
B. During the first 3–5 days of acute illness
C. Several weeks after symptom resolution
D. Only after antibody production begins

2. Which type of swab should be avoided for viral specimen collection because it may inhibit PCR?

A. Dacron swab
B. Rayon swab
C. Calcium alginate swab
D. Flocked nylon swab

3. What is the recommended temperature range for short-term storage of viral specimens?

A. −70°C or lower
B. −20°C
C. 2–8°C
D. 20–25°C

4. Which cytopathic finding is classically associated with Cytomegalovirus (CMV)?

A. Multinucleated giant cells
B. Cowdry A inclusion bodies
C. “Owl’s eye” intranuclear inclusions
D. Syncytia only

5. What is the main advantage of the shell vial technique?

A. It eliminates the need for cell culture
B. It allows rapid viral detection within 24–48 hours
C. It detects only viral antibodies
D. It requires electron microscopy

6. Which viral marker is particularly useful for detecting early HIV infection before antibodies develop?

A. HBsAg
B. HIV IgG
C. HIV p24 antigen
D. CMV IgG

7. Which molecular technique is appropriate for viruses with RNA genomes such as Influenza and SARS-CoV-2?

A. Standard PCR only
B. RT-PCR
C. Sanger sequencing only
D. Electron microscopy

8. In real-time PCR, what does a lower Ct value generally indicate?

A. Lower amount of target nucleic acid
B. Higher amount of target nucleic acid
C. Absence of viral nucleic acid
D. Higher antibody concentration

9. Which sequencing approach is particularly useful for unknown pathogen discovery and unbiased analysis?

A. Sanger sequencing
B. NGS/metagenomics
C. Standard PCR
D. ELISA

10. Which antibody generally appears earlier during a primary viral infection?

A. IgG
B. IgA
C. IgM
D. IgE

11. A patient has a positive PCR but negative serology. Which interpretation is most consistent with the lecture?

A. Past infection only
B. Hyper-acute infection
C. Post-vaccination immunity
D. False-positive PCR in every case

12. What is reassortment in viral genetics?

A. Random changes in variant frequency
B. Exchange of genetic material between two related viral genomes
C. Exchange of entire genome segments between viruses with segmented genomes
D. Accumulation of mutations caused by selection

Thank You!