13.7A: Antiviral Agents that Prevent Virus Uncoating or Release

Different approaches are used to target the initial and final steps of a virus life cycle.

Learning Objectives

• Compare the mechanisms of the discussed antiviral drugs

Key Points

• The attachment step is targeted by molecules that will block the receptor on the host cell surface, or on the viral capsid region responsible for binding to the host receptor.

• Drugs that target the uncoating step bind to, and inactivate, proteins on the capsid surface responsible for the uncoating.

• The release step is targeted by drugs that inhibit the activity of neuraminidase, an enzyme on the viral surface.

Key Terms

• sialic acid: A derivative of neuraminic acid (a nine-carbon monosaccharide) that is often the sugar part of glycoproteins.

A viral infection starts with entry of the virus into the cell. The entry mechanism is complex, consists of multiple steps and involves host cell structures.
Targeting the Attachment Step

Virus infection starts with a virus attaching to the host cell by binding to a receptor molecule. There are two main strategies used to design antiviral drugs at this step:

- Using molecules that will bind to the cell receptor and inactivate it; thus preventing the virus from attachment. Examples include anti-receptor antibodies or natural ligands that can bind to the receptor.
- Using receptor-like molecules to bind to the virus and inactivate it before it meets the cell. These include anti-virus antibodies (with specificity against the viral structure that binds to the receptor) or synthetic molecules that mimic the receptor.

The search for such drugs, however, is very expensive and time-consuming.

Targeting the Uncoating Step

Another drug target is the uncoating step during viral infection. Uncoating is the process of capsid disintegration, which leads to the release of the genomic material. This step is performed by viral or host enzymes, or by capsid dissociation alone. Drugs that can perform such functions are used against the influenza virus, rhinoviruses (the cause of the common cold), and enteroviruses (gastrointestinal infections, meningitis, etc.). It is believed that such drugs prevent the virus from uncoating by blocking the proteins on the capsid responsible for uncoating, such as ion channel proteins. An example of such a drug is Rimantadine, which blocks the ion channel in the influenza virus. The ion channel has an important role in disintegrating the viral capsid.

Figure: Structure (3D) of the Influenza Virus: The image depicts the major components of the virus structure, including the neuraminidase.

Targeting the Release of the Newly Formed Viral Particles

The last step in the virus life cycle—release from the cell—has been targeted by drugs as well. Neuraminidase is an enzyme on the capsid of influenza virus. It cleaves sialic acid from glycoproteins on the surface of the host cell and allows the viral particles to leave the cell. Tamiflu and Relenza are trend names of two drugs used to treat influenza.
infections by targeting neuraminidase.

Since viruses use many structures in the host cells to replicate, designing or discovering good antiviral drugs that will not affect the eukaryotic cells is a challenging task. Serious side effects are often observed with the use of antiviral drugs, as is resistance against the drugs. Developing drugs that inhibit different steps in the virus life cycle is of critical importance.