Viral Replication

I. Steps in Viral Replication

A. Attachment.

This is the first step in viral replication. Surface proteins of the virus interact with specific receptors on the target cell surface. These may be specialized proteins with limited distribution or molecules that are more widely distributed on tissues throughout the body. The presence of a virus-specific receptor is necessary but not sufficient for viruses to infect cells and complete the replicative cycle.

B. Penetration.

Enveloped viruses (e.g., HIV, influenza virus) penetrate cells through fusion of the viral envelope with the host cell membrane. Non-enveloped viruses penetrate cells by translocation of the virion across the host cell membrane or receptor mediated endocytosis of the virion in clathrin coated pits with accumulation of viruses in cytoplasmic vesicles.

C. Uncoating (disassembly).

A complex process which differs by taxonomic class and is not fully understood for many agents. This process makes the nucleic acid available for transcription to permit multiplication of the virus.

D. Transcription and Translation

The key to understanding the genomic expression of viruses is noting the fact that viruses must use host cellular machinery to replicate and make functional and structural proteins. Strategies for genomic expression for different taxonomic groupings of viruses are described below (section II).

F. Assembly and Release.

The process of virion assembly involves bringing together newly formed viral nucleic acid and the structural proteins to form the nucleocapsid of the virus. There are basically three strategies that viruses employ:

1. Nonenveloped viruses exhibit full maturation in the cytoplasm (e.g., picornaviruses) or the nucleus (e.g., adenoviruses) with disintegration of the cell and release of virions.

2. For enveloped viruses, including the (-) strand RNA viruses, the (+) strand togaviruses and the retroviruses, final maturation of the virion takes place as the virion exits the cell. Viral proteins are inserted into the host cell membrane. Nucleocapsids bind to the regions of the host cell membranes with these inserted proteins and bud into the extracellular space. Further cleavage and maturation of proteins may occur after viral 2 extrusion to impart full infectivity on the virion. Viruses in this group differ in their degree of cytolytic activity.

3. Herpesviruses, which are enveloped viruses, assemble their nucleocapsids in the nuclei of infected cells and mature at the inner lamella of the nuclear membrane. Virions accumulate in this region, in the endoplasmic reticulum and in vesicles protected from the cytoplasm. Release of virions from the cell surface is associated with cytolysis.

<http://www.columbia.edu/itc/hs/medical/pathophys/id/2004/lecture/notes/viral_rep_Hammer.pdf>