CYTOPATHOGENIC EFFECT

Cytopathic effect or cytopathogenic effect (CPE) refers to structural changes in host cells that are caused by viral invasion. The infecting virus causes lysis of the host cell or prevents the reproduction of existing cells. Both of these effects occur due to CPEs. If a virus causes these morphological changes in the host cell, it is said to be cytopathogenic.

CPEs and other changes in cell morphology are only a few of the many effects by cytocidal viruses. When a cytocidal virus infects a permissive cell, the viruses kill the host cell through changes in cell morphology, physiology, and the biosynthetic events that follow. These changes are necessary for efficient virus replication but at the expense of the host cell.

COMMON TYPES OF CPEs

Total destruction

Total destruction of the host cell monolayer is the most severe type of CPE. To observe this process, cells are seeded on a glass surface and a confluent monolayer of host cell is formed. Then, the viral infection is introduced. All cells in the monolayer shrink rapidly, become dense in a process known as pyknosis, and detach from the glass within three days. This form of CPE is typically seen with enteroviruses.

Subtotal destruction

Subtotal destruction of the host cell monolayer is less severe than total destruction. Similarly to total destruction, this CPE is observed by seeding a confluent monolayer of host cell on a glass surface then introducing a viral infection. Subtotal destruction characteristically shows detachment of some but not all the cells in the monolayer. It is commonly observed with some togaviruses, some picornaviruses, and some types of paramyxoviruses.

Focal degeneration

Focal degeneration causes a localized attack of the host cell monolayer. Although this type of CPE may eventually affect the entire tissue, the initial stages and spreading occur at localized viral centers known as foci. Focal degeneration is due to direct cell-to-cell transfer of the virus rather than diffusion through the extracellular medium. This different mode of transfer differentiates it from total and subtotal destruction and causes the characteristic localized effects. Initially, host cells become enlarged, rounded, and refractile. Eventually, the host cells detach from the surface. The spreading of the virus occurs concentrically, so that the

cells lifting off are surrounded by enlarged, rounded cells which are surrounded by healthy tissue. This type of CPE is characteristic of herpesviruses and poxviruses.

Swelling and clumping

Swelling and clumping is a CPE where host cells swell significantly. Once enlarged, the cells clump together in clusters. Eventually, the cells become so large that they detach. This type of CPE is characteristic of adenoviruses.

Foamy degeneration

Foamy degeneration is also known as vacuolization. It is due to the formation of large and/or numerous cytoplasmic vacuoles. This type of CPE can only be observed with fixation and staining of the host cells involved. Foamy degeneration is characteristic of certain retroviruses, paramyxoviruses, and flaviviruses.

Syncytium

Syncytium is also known as cell fusion and polykaryon formation. With this CPE, the plasma membranes of four or more host cells fuse and produce an enlarged cell with at least four nuclei. Although large cell fusions are sometimes visible without staining, this type of CPE is typically detected after host cell fixation and staining. Herpesviruses characteristically produce cell fusion as well as other forms of CPE. Some paramyxoviruses may be identified through the formation of cell fusion as they exclusively produce this CPE.

Inclusion bodies

Inclusion bodies - insoluble abnormal structures within cell nuclei or cytoplasm - may only be seen with staining as they indicate areas of altered staining in the host cells. Typically, they indicate the areas of the host cell where viral protein or nucleic acid is being synthesized or where virions are being assembled. Also, in some cases, inclusion bodies are present without an active virus and indicate areas of viral scarring. Inclusion bodies vary with viral strain. They may be single or multiple, small or large, and round or irregularly shaped. They may also be intranuclear or intracytoplasmic and eosinophilic or basophilic.