1.7 How do cells show viral growth?

Welcome again! Sometimes, the viral infection of the cell produces morphological alterations visible under the microscope or even with the naked eye. They are the result of physiological changes, of biosynthesis (as the blocking of the synthesis of nucleic acids and proteins) or genetic (because the virus produces mutations). They are produced directly by the virus, or as a result of the cell response to the viral infection.

These morphological changes constitute the cytopathic effect, and viruses that produce it are called cytopathogenic. Many times the cytopathic effect gives a clear indication of which virus is infecting the cell, and this is very useful for the diagnosis. In general, the cellular alterations are observed best when the cells are stained, for example with eosin, crystal violet or Giemsa, but there are times when we can even see them with the naked eye. We must be aware that many times viral infection does not produce any cytopathic effect. In this video we will see some types of cytopathic effects.

Cell lysis

One of the most characteristic is the cell lysis, easier to detect in adherent cells than in suspension cells. In healthy cultures, the cells occupy the entire surface until they completely cover it without mounting on each other. This is called a monolayer. Well, when there is lysis, the cells swell and become rounded, forming aggregates and detaching. This starts from a small area that widens. This way a plate is formed that may be seen macroscopically. We can determine the number of viruses in a sample counting plates, because it is estimated that each plate derives from an initial virus.

Syncytia

During the replication of some enveloped virus, in the cell membrane of the infected cell viral fusion proteins are inserted that induce the fusion with the other adjacent cell membranes. The result is that they combine the cytoplasm of the cells involved, but not the nuclei. If this brings together several cells, multinucleate cells are formed, which are called syncytia. For the virus, this means that it can infect cells without exposing itself to the extracellular space, where it can be neutralized by antibodies. But it is a short-term solution, because the syncytia end up dying. On many occasions the syncytia are called "giant cells". The infection by cytomegalovirus causes precisely that, and that is from where the virus gets its name.

Inclusion bodies

In some viral infections we can see in the stained cells the so-called inclusion bodies. These are abnormal structures in the nucleus or in the cytoplasm that are stained characteristically with basic dyes (and are called basophilic inclusion bodies) or with acid dyes (called eosinophilic inclusion bodies). They represent sites of viral replication and they usually are accumulation of proteins of the viral capsids, or accumulation of newly synthesized nucleic acids or places of assembly of the virions. They can also be organelles or degenerated cellular structures. They are very varied and frequently its detection in certain cells confirms the diagnosis. This is the case of the presence of Negri bodies in Purkinje cells for the diagnosis of rabies. But there are many more examples.

Accelerated growth

Some viruses are oncogenic and they may induce tumours by different mechanisms. The oncogenic effect of viruses can also be seen in vitro by the rapid multiplication of cells in culture, sometimes so fast that it gives them no time to spread and they remain aggregated as we can see in this picture.

Apoptosis

We will finish our tour on the different types of cytopathic effects with the apoptosis or programmed cell death. We can see this under the electron microscope as cells in which there is chromatin condensation and chromosomal DNA fragmentation. Apart from that, we can see the development of vesicles in the plasma membrane, known as blebbing, although the membrane does not change substantially. This avoids the immune system from noticing that the cell is infected. In addition, the organelles disintegrate and collapse, and the cell splits up into apoptotic bodies that are phagocytosed by macrophages. Some viruses induce apoptosis, while others inhibit it. In any case, it can be a mechanism of evading the defences of the host.

In this video we have seen the morphological alterations that the virus-infected cells experience. After doing the exercises corresponding to this activity you should check your knowledge in the test that we propose. See you in the next video!

Thank you very much for your attention.