5.3 The body: a battlefield

When a virus infects an individual, many times it triggers a great battle that the body is going to suffer, producing a series of injuries directly, by the effect of the virus, or indirectly, by the immune response that develops against it. In this video we will see how these lesions are studied and interpreted. Keep in mind that the lesions tend to be the same in different individuals infected with the same virus, so their correct interpretation has diagnostic value. The science that deals with the study of the changes in the structure and composition of tissues and organs in the course of the diseases, examines the causes, development, and consequences is called pathological anatomy of pathology. It includes three types of techniques: necropsy, biopsy and cytological examination.

The necropsy is the study of the animal body. It is the equivalent of the autopsy of persons, that we will not be talking about here. My teachers used to tell me that the autopsy should be ordered, complete and systematic. The careful study of the cadaver will allow to take the adequate **samples** for the analysis. In this video we will use mice as example.

An ordered necropsy begins with the external inspection, paying attention to:

- the body state, i.e., if the animal is cachectic, as you can see in this image, or on the other hand it is overweight or even obese;
- The state of the hair, if it has alopecia or lack of hair in any area;
- If there are wounds, abrasions, significant tumors, etc.

Then, we cut the skin to observe the subcutaneous tissue and we open consecutively the abdominal, thoracic and cranial cavities, studying the lymph nodes, the glands in the subcutaneous connective tissue, and the organs contained in these cavities.

A fundamental point is the macroscopic description of the lesions, observing the following points:

- their location (recording the organ, if it is uni or bilateral, in paired organs, if they are in cranial, dorsal, ventral position, etc.),
- their distribution in the body;
- the size of the lesion after measuring it;
- its shape,
- its surface,
- its color,
- how are the edges, and
- its consistency

The next step is to take samples. This should be done as soon as possible after death. Samples should include a healthy edge to compare the injured tissue with the healthy one.

When tissue or cell samples are taken from an animal or person alive they are called **biopsies** and scrapings.

To process samples, biopsies or cytology, it is often necessary to fix them first, to stop the processes of tissue autolysis. There are different substances which fulfill this function, such as buffered formaldehyde, paraformaldehyde, glutaraldehyde, or Bouin liquid. The fixative of choice is 4% buffered formaldehyde. It preserves cellular structures and it allows that multiple staining techniques are performed, including immunocytochemistry. The only drawback is that it is a carcinogen and mutagen, so when using it, we need to take extra precautions.

Tissue samples tend to be very thick to see them under a microscope. Therefore it is necessary to make **thin sections** first, but as they are soft tissue, it is not easy. We can do two things to give consistency to the tissue: either include the samples in substances such as **paraffin**, or **ultrafreeze** them. In this second case, the samples are frozen in liquid nitrogen and cut while still frozen. It is not necessary to fix them, and it is especially useful to preserve the proteins that degrade with fixatives.

And finally, we come to the last step, consisting of staining the tissue to be able to observe the different structures. Tissues are most commonly stained with haematoxylin and eosin, which stain nuclei in blue, and cytoplasm collagen in pink, respectively. But there are other many stains that highlight different cellular components, such as lipids, mucopolysaccharides, etc.

Samples can also be dyed or viewed using other techniques, about some of which we have already spoken, for example:

- Immunofluorescence, using specific antibodies against certain viral proteins marked with a fluorochrome.
- Peroxidase-antiperoxidase (or PAP), in which the antibody is detected with a second antibody labelled with peroxidase.
- Or in situ hybridization that allows the detection of specific sequences of DNA and RNA using labelled probes.

And with this we end this important issue. Remember to do the exercises that we propose to make sure that you understand everything. Thank you for your attention!