

# Cellular inclusions

Inclusions are parts of the cytoplasm that may or may not be bounded by a membrane.

## Functions

Inclusions accumulate some metabolites or deposits of various substances (e.g. pigments). They may also contain some enzymes, but they do not fundamentally interfere with the metabolic processes in the cell and are activated outside it. They are not usually a permanent part of the cytoplasm of the cell.

## Division

### Lipid inclusions

They are mostly found in cells as lipid droplets. They are homogeneous, have a medium electron-dense content and can be bounded by a membrane, which, however, usually disintegrates. They maintain their shape thanks to vimentin intermediate filaments. We find them mainly in the cells of adipose tissue, the cortex of the adrenal glands or in the liver cells.

### Carbohydrate inclusions

They occur in visible form in cells in the form of glycogen. Glycogen occurs as electron-dense particles of irregular shapes with a diameter of about 20 nm. The particles are referred to as  $\beta$  granules, which clump together to form rosettes, which we call  $\alpha$  granules.

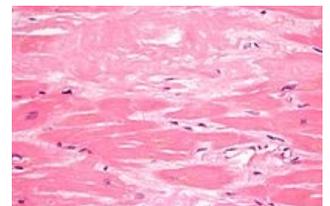
### Protein inclusions

They are mostly found in cells in the form of secretory granules that have a diameter of 0.2–2  $\mu\text{m}$ , are bounded by a membrane and are periodically released or emptied into the extracellular space. Carbohydrate molecules also bind to the proteins that form the basis of the secretory material. Secretory granules may also contain substances (e.g. digestive enzymes and proenzymes) that can damage the cytoplasm of the cell, we call these granules zymogen.

## Deposits of various colored substances (pigments)

### Exogenous pigments

Various dust particles from **the external environment** can penetrate the cells and reach the organs of the respiratory system by inhalation, e.g. coal dust and particles containing metals (especially iron). Pigments can also enter cells through food. First of all, carotenes, which, thanks to their affinity for fats, color the fat droplets of adipocytes orange.



Lipofuscin granules in the myocardium

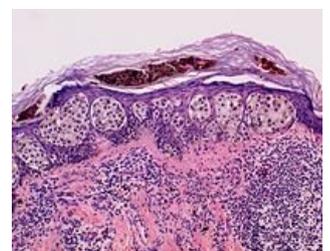
### Endogenous pigments

Products of the own organism and we divide them into autogenous and hematogenous.

#### Autogenous pigments

**Melanin** – a product of melanocytes, occurs in the form of electron-dense granules, is black or brown-black, and is found in skin cells and in the retina of the eye.

**Lipofuscin** – a yellow-brown pigment that forms the accumulation of residual bodies in cells. Its amount increases in cells with age ("pigment from wear and tear").



Melanin granules in superficial spreading melanoma

#### Hematogenous pigments

Hemoglobin breakdown products.

In the cells of these substances, we find hemosiderin, which is rusty brown and occurs in membrane-bound granules called siderosomes. The content of siderosomes is a heterogeneous mixture of ferritin, lysosomal enzymes, carbohydrates and lipids.

## Links

## Related Articles

- Organelles
- Cell

## References

- VAJNER, Luděk – UHLÍK, Jiří – KONRÁDOVÁ, Václava. *Lékařská histologie. 1, Cytologie a obecná histologie. 1.* edition. Praha : Karolinum, 2010. pp. 110. ISBN 978-80-246-1860-9.