

# Cell Death

## Cell Death - Apoptosis

### Definition of Cell Death

Apoptosis is a specific type of cell death that characterized by: reduced cell size; the nucleus fragments into nucleosome-size fragments; the plasma membrane remains intact, but altered, especially in relation to the lipid orientation; the cellular contents remain intact, by may be released in apoptotic bodies; there is not adjacent inflammation; and is often physiologic as a means of eradicating unwanted cells, however, may be pathologic after certain forms of cell injury like DNA damage

### Pathophysiology of Cell Death

Normal pathophysiology in apoptosis takes place during embryogenesis; involution of dependent tissue after hormone withdrawal; loss of cells after proliferation; elimination of lymphocytes after useful function is performed in order to keep the cells from being self-reactive. Death of cells by apoptosis occur in many pathologic states:

- Severe cell injury – Apoptosis takes place when repair mechanisms fail. Free radicals can cause DNA damage either directly or indirectly.
- Accumulation of misfolded proteins – This occurs when free radicals mutate, causing excessive misfolds in the endoplasmic reticulum (ER). When this occurs it causes ER stress, which has been linked to many degenerative disorders in the CNS and other body organs.
- Infections (primarily viral) – The bodies host immune response is either directly or indirectly responsible for apoptosis of a virus. In the process it can cause damage to tissue and has the same effect on tumor cells and rejection of tissue transplant.
- Obstruction in tissue ducts – When there is an obstruction in ducts, such as the pancreas, parotid glands or kidneys, the process of apoptosis can cause pathologic organ shrinking.

## Genetics

There is evidence of certain genetic disease processes being traced back to mutations of apoptosis. Some examples of this are:

- Mutation in TNF R1 – linked to familial periodic fever disorder
- Mutation in CD95 – linked to solid tumors, malignant lymphomas and Autoimmune lymphoproliferative syndrome type I (ALPS I)
- ALPS II has a defect in Capase 10
- Mutation in bcl10 – linked to mucosa-associated lymphoid tissue lymphoma and other non-hematologic growths
- These are just a few. There are many more\*\*

## Epidemiology

Enzymes, known as caspases, initiate apoptosis. Caspases are in all cells and are initially inactive until activated by Bcl2 and IAP. The activation process starts either intracellular or extracellular by death signals. In a normal functioning process, apoptosis occurs as a result of cells no longer needed by the body or cells that are a threat to the body.

## Description of Disease

Apoptosis is a normal cell function. It becomes a problem when there is an excessive or insufficient degree of apoptosis taking place. When there is a decrease in the rate of apoptosis it provides for the survival of abnormal cells. When there is an overactive rate of apoptosis it has been known to lead to certain neurodegenerative problems, ischemic injuries and the death of cells in several viral infections.

## Signs and Symptoms

Signs and symptoms would be dependent on which apoptosis dysfunction is occurring: excessive or insufficient. Depending on which dysfunction is occurring relates directly to which disease process might occur:

## Diagnosis

Apoptosis is a continually occurring function in the body, so no diagnosis would take place. It is possible to take an already occurring disease process and trace it back to the origins of a dysregulated apoptosis process.

## Treatment

Apoptosis is a normal cell function, therefore requires no treatment. The only treatment would be to treat specific conditions that arise from dysregulated apoptosis, and that would be on a case-to-case basis depending on the disease processes that arises from the dysfunction..

## Links

National Center for Biotechnology Information (<http://www.ncbi.nlm.nih.gov>) [1] (<http://www.ncbi.nlm.nih.gov>)  
<http://www.ncbi.nlm.nih.gov>

- Apoptosis signaling disorders in tumor cells
- Apoptosis and clinical consequences of disorders of its regulation
- Necrosis
- Apoptosis and clinical consequences of disorders of its regulation

## Related Article

Mullauer, L., Gruber, P., Sebinger, D., Buch, J., Wohlfart, S., Chott, A. (2001). Mutation in apoptosis genes: A pathogenetic factor for human disease. *Mutation Research*, 488(3), 211-231.

## References

McCance, K., Huether, S., Brashers, V., and Rote, N. (2010). *Pathophysiology: The biological Basis for disease in adults and children* (6th ed.). St. Louis, MO: Elsevier Saunders.