

Apoptosis

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Abstract: There are two ways for cell dying: (1) By injury or disease. (2) Suicide. Programmed cell death is also called apoptosis - cell suicide. Apoptosis is that the cells undergo death to control cell proliferation. There are 3 different mechanisms by which a cell commits suicide by apoptosis: (1) Generated by signals arising within the cell; (2) Triggered by death activators binding to receptors at the cell surface; (3) Triggered by disadvantaged environment. Besides animal, plant also performs the apoptosis. [Nature and Science. 2005;3(2):1-4].

Key Words: apoptosis; cell; death

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Introduction

For all the things existed, including the life cells in the earth and universe itself, there is a time to live and a time to die. There are two ways in which cells die: (1) Killed by injury or disease. (2) Suicide. Programmed

cell death is also called apoptosis, which is cell suicide. Apoptosis is a mechanism by which cells undergo death to control cell proliferation or in response to DNA damage. Some types of cancer cells, such as B-cell chronic lymphocytic leukemia, follicular lymphoma (Tsuji moto, 1985) and tumors infected by human T-cell

leukemia/lymphoma virus-1 (Hengartner, 2000) are characterized by defects in apoptosis leading to immortal clones of cells. Other malignancies have defects in the apoptotic regulatory pathways such as p53 (Kaufmann, 2001). Apoptosis plays an important role in the pathogenesis of cholesteatoma (Olszewska, 2005). The understanding of apoptosis has provided the basis for novel targeted therapies that can induce death in cancer cells or sensitize them to established cytotoxic agents and radiation therapy (Ghobrial, 2005).

Kiseleva, Krylov, Lyudyno and Suvorov recently showed that Vascular endothelial growth factor modulated mitogen-induced proliferation of thymocytes and stimulated spontaneous apoptosis in intact thymus cells (Kiseleva, 2005).

Stoka and Turk described an emphasis to the newly discovered role of lysosomal cathepsins in apoptotic pathways (Stoka, 2005).

1 Death by Injury

Life cells can be killed by injury, such as mechanical injury and toxic environment injury. In the cell dying procedure by injury, the cells undergo a characteristic series of changes, such as the three changes: (1) Cells swell because the disability of the plasma membrane controlling the passage of ions and water. (2) Leak out of cell contents. (3) Inflammation of surrounding tissues. For example, various factors, including nucleotide depletion, electrolyte imbalance, reactive oxygen species, endonucleases, disruption of mitochondrial integrity, and activation of various components of the apoptotic machinery, have been implicated in renal cell vulnerability (Padanilam, 2003).

2 Death by Suicide – Apoptosis

Cell death by suicide is called apoptosis. The apoptosis has the following characterizations: (1) Cell movement is disabled. (2) Nuclear acids and degrade. (3) Cells shrink. (4) Cells appear non-regular shapes on their surface. (5) Water is lost. (6) Cell organelle break down. (7) Cells break into small fragments. Then the cells suicide and died.

3 Why Should a Cell Need Apoptosis as the Suicide?

3.1 There could be two reasons for suicide

(1) Mitosis needs apoptosis. For example: A. The frog re-absorbs the tadpole tail when its metamorphosis changes into a frog. B. The formation of fingers and toes requires the removal of the tissue by apoptosis. C. The sloughing off of the inner lining of the uterus by apoptosis. D. The formation of proper connections between neurons in brain requires surplus cells to be eliminated by apoptosis. (2) Apoptosis is needed to remove cells that hurt the integrity of the organism. For example: Cells infected with bacteria, viruses or other toxic organisms.

3.2 DNA damage causes apoptosis

Genome damage can cause a cell disrupted properly. This is an auto-regulation process that is important for the cell development.

3.3 Cell immune system causes apoptosis

In the immune procedure, the apoptosis plays an important role. To remove non-needed parts of the cells by apoptosis is happened in programmed cell death procedure.

3.4 Cancer cells

For cancer therapy, radiation and chemicals could induce apoptosis. Tipping the balance between cell death and proliferation in cell survival could cause tumor formation. And, killing cancer cells by chemical therapies depends on activation of apoptosis procedures. Therefore, failure to undergo apoptosis in the therapy could result in cancer resistance (Fulda, 2004).

4 What Makes the Apoptosis?

4.1 The balance between positive and negative signals

The balance between the positive signals and negative signals plays important roles in the apoptosis procedures. This is important in the cell's life.

4.2 Positive signals

For the life, cells need to receive continuous stimulation from other cells and, for many, continued adhesion to the surface on which they are growing. These stimulation signals are called signals, such as: growth factors, interleukin-2, etc.

4.3 Negative signals

When the apoptosis happens, the following results could occur: (1) Oxidant level within the cell is increased. (2) DNA is damaged by these oxidants or other agents like ultraviolet light, x-rays, etc. (3) non-properly folded proteins are accumulated. (4) Molecules that bind to specific receptors on the cell surface appear. (5) Some signals related to apoptosis begin to appear.

5 The Mechanisms of Apoptosis

There are 3 different mechanisms of apoptosis: (1) Generated by signals in a cell; (2) Triggered by death factors on cell surface. (3) Triggered by toxic factors.

5.1 Apoptosis caused by internal signals

These signals could be Bcl-2, Apaf-1 (apoptotic protease activating factor-1), Bax, cytochrome c, caspase 9, ATP, etc.

5.2 Apoptosis caused by external signals

Fas, FasL, TNF, TNF receptor, etc could be related to the by external signals.

6 Apoptosis and Cancer

There is closed relationship between apoptosis and cancer and many studied have been reported for this relationship. The research results show that several human papilloma viruses could cause cervical cancer. One of them produces a protein (E6) that binds and inactivates the apoptosis promoter p53. These actions make the cell more resistant to apoptosis.

6.1 Some B-cell leukemias and lymphomas block apoptotic signals.

6.2 Melanoma cells avoid apoptosis by inhibiting the expression of the gene encoding Apaf-1.

6.3 Some cancer cells, secrete elevated levels of a soluble "decoy" molecule that binds to FasL, plugging it up so it cannot bind Fas.

6.4 Some cancer cells express high levels of FasL and they can kill cytotoxic T cell that kills them because cytotoxic T cells also express Fas.

7 Apoptosis and AIDS

Infection with the human immunodeficiency virus type 1 (HIV-1) leads to progressive immunodeficiency. The loss of immune competence is associated with declines in both the functionality and the number of

CD4+ lymphocytes. In vitro explorations on the cytopathic effects of HIV-1 have yielded a wealth of potential triggering events, and signaling and effector pathways leading to apoptosis. The types of pro- and anti-apoptotic stimuli that have been associated with HIV-1 are multiple and often appear overlapping or even contradictory (Roshal, 2001). When the infected T cell encounters an uninfected one, the interaction of FasL with Fas on the uninfected cell kills it by apoptosis.

8 Apoptosis in Plants

Besides animal, plant also performs the apoptosis, that turns on a system of programmed cell death. The mechanism differs from that in animals although it, too, involves a protease that — like caspases — cleaves other proteins at Asp and Asn residues. Activation of this enzyme destroys the central vacuole, which is followed by disintegration of the rest of the cell. ()

9. Apoptosis and Human Society

Are there apoptosis in the human social system? There must be yes. All the social systems should have apoptosis mechanisms to program their life. No social system can survive forever, no matter it is a socialism society or a capitalism society, and no matter it is the current Chinese social system or the current American social system. The apoptosis principle must applicable to the human society.

10. Discussions

No matter it is a unique or a universal phenomenon of the earth life in the universe, all the earth life should be died, although we can imagine that the single cell life body can live "forever" through the forever dividing, I personal consider that all the life must die. Even the universe could be die. Are there programs to control this birth and die? Nobody knows. The studies of apoptosis are not only a bioscience application, but also a scientific conception and a philosophy. This concept of apoptosis reveals that the life has a law to make the life to automatic dying.

Apoptosis is the biochemical protocol for the life body in the earth. If a life is come out in the world, it automatically creates a way that the life tries to survive as longer as possible, which likes that we human wish.

But, everybody will be old and died finally, including all the human men/women.

Apoptosis is a universal event in the universe, that happens in all the life bodies and azoic things in the universe, including the universe itself. To understand apoptosis clearly will be important to the health science and also meaningful to the understand of the basic nature laws.

Is there any possibility for us to find some ways to remove apoptosis, so that we can live forever? From the theory point, everything is possible. It is possible for us to find a way to completely remove the apoptosis of human bodies. When this goal is accomplished, people can live at a specific age forever. Interesting? Exciting? The answer is yes, of course!!!

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