Apoptosis "A Cellular Commit Suicide"

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Introduction:

In 1842, Carl Vogt, German scientist was first to report the principle of apoptosis. Walther Flemming, anatomist delivered a more precise description of the process of programmed cell death in 1885(1). However, it was not until 1965 that the topic was resurrected. While studying tissues using electron microscopy, John Foxton Ross Kerr at University of Queensland was able to distinguish apoptosis from traumatic cell death(2).

Apoptosis is a programmed cell death .The pathway of cell death is induced by a tightly regulated suicide program in which cells destined to die activate enzymes capable of degrading the cells' own nuclear DNA and nuclear and cytoplasmic proteins.

The main characterized features of cell death are:

• single cells (not large groups of cells)

Fragments of the apoptotic cells then break off, giving the appearance that is responsible for the name (apoptosis, "falling off"). The plasma membrane of the apoptotic cell remains intact, but the membrane is altered in such a way that the cell and its fragments become avid targets for phagocytes. The dead cell is rapidly cleared before its contents have leaked out, and therefore cell death by this pathway does not elicit an inflammatory reaction in the host(3)

• cells shrink with formation of apoptotic bodies

• gene activation with formation of endonucleases

Thus, apoptosis differs from necrosis, which is characterized by loss of membrane integrity, enzymatic digestion of cells, leakage of cellular contents, and frequently a host reaction

• peripheral condensation of chromatin with DNA ladder

• without inflammatory response

However, apoptosis and necrosis sometimes coexist, and apoptosis induced by some pathologic stimuli may progress to necrosis.

Mechanisms: Apoptosis is an active enzymatic process in which nucleoproteins are broken down and then the cell is fragmented. The fundamental event in apoptosis is the activation of enzymes called caspases (so named because they are cysteine proteases that cleave proteins after aspartic residues). Activated caspases cleave numerous targets, culminating in activation of nucleases that degrade DNA and other enzymes that presumably destroy nucleoproteins and cytokeletal proteins. The activation of caspases depends on a finely tuned balance between pro- and anti-apoptotic molecular pathways(4) .

Two phases

1) initiation phase : characterized by caspases activation

b) execution phase characterized by cell death which occurs into / **two distinct pathways**

i) extrinsic needed receptor-mediated pathway

mediated by cell surface death receptors

type 1 TNF receptor (TNFR1) and Fas (CD95)

ii) intrinsic (or mitochondrial) pathway which

increased permeability of mitochondria example is cytochrome c released into cytoplasm via bax channels.

Types of apoptosis:

Apoptosis occurs normally in many situations, and serves to eliminate potentially harmful cells and cells that have outlived their usefulness. It is also a pathologic event when cells are damaged beyond repair, especially when the damage affects the cell's DNA or proteins; in these situations, the irreparably damaged cell is eliminated.

1) physiologic type: Death by apoptosis is a normal phenomenon that serves to eliminate cells that are no longer needed and to maintain a steady number of various cell populations in tissues. It is important in the following physiologic situations :

- cell death within germinal centers of lymph nodes
- involution of thymus
- lactating breast during weaning
- fragmentation of endometrium during menses
- The term "programmed cell death" was originally coined to denote death of specific cell types at defined

times during the development of an organism. Apoptosis is a generic term for this pattern of cell death, regardless of the context, but it is often used interchangeably with "programmed cell death."Involution of hormone-dependent tissues upon hormone deprivation, such as endometrial cell breakdown during the menstrual cycle, and regression of the lactating breast after weaning .Cell loss in proliferating cell populations, such as intestinal crypt epithelia, so as to maintain a constant number. Death of cells that have served their useful purpose

2) pathologic type

Apoptosis eliminates cells that are genetically altered or injured beyond repair without eliciting a severe host reaction, thus keeping the damage as contained as possible. Death by apoptosis is responsible for loss of cells in a variety of pathologic states(5)

- type IV hypersensitivity
- cytotoxic T cell–mediated immune destruction
- viral hepatitis

- DNA damage
- Radiation
- cytotoxic anticancer drugs
- extremes of temperature
- hypoxia can damage DNA, either directly or via production of free radicals.

Conclusion:

We are most grateful to Professor James Cormack of the Department of Greek, University of Aberdeen, for suggesting this term. The word "apoptosis" (Greek spelling of apoptosis)(1,3) is used in Greek to describe the "dropping off" or "falling off" of petals from flowers, or leaves from trees. It is a simple safe fundamental principles of life

Showing that if repair mechanisms cannot cope with the injury, the cell triggers intrinsic mechanisms that induce apoptosis. In these situations, elimination of the cell may be a better alternative than risking mutations in the damaged DNA, which may progress to malignant transformation.

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