

Cell Injury

The normal cell has to live within a fairly narrow range of function and structure. Even then, It can handle normal physiological demands, so-called normal homeostasis. Somewhat more excessive physiological stresses, or some pathological stimuli, bring about adaptation. That is, the cell modifies its structure and function in response to changing demands and stresses. It then acquires a new but steady-state and preserves its health. For example, the bulging muscles of a racehorse result from cellular adaptations. The increase in muscle mass is due to an increase in the size of the individual muscle fibers. The workload is thus shared by a greater mass of cellular components, and each muscle fiber is spared from excess work and therefore escapes injury. This adaptive response is called hypertrophy. Conversely, atrophy is a response in which there is a decrease in the size and function of cells. Hyperplasia and metaplasia are the other examples of adaptive responses.

If the adaptive capability is exceeded, or in certain cases when adaptation is not possible, a sequence of regressive changes occurs, collectively known as cell injury (L. re, retro = back; gress = step, i.e., step back, go back, fall in health; also called retrogressive or degenerative changes). In classical or traditional pathology, these changes were termed "degenerations", but now they are called cell injury. Within certain limits, injury is reversible and cells return to a normal state, but with severe and persistent stress, the cell reaches a 'point of no return', suffers an irreversible injury, and then dies. Adaptation, reversible injury, irreversible injury, and cell death are states of progressive encroachment on the cell's normal function and structure.

Cell death

Cell death, the ultimate result of cell injury, is one of the most important events in pathology, affects every type of cell, and is the main result of ischemia (lack of blood flow), infections, toxins, and immune reactions. There are two main patterns of cell death: necrosis and apoptosis.

Necrosis (typically coagulative necrosis) is the more common type of cell death and occurs after a loss of blood supply or after exposure to toxins. It is characterized by cellular swelling, denaturation and coagulation of cytoplasmic proteins, and breakdown of the organelles.

Apoptosis occurs when a cell dies through activation of an internally controlled 'suicide' program. After this, the dead cells are removed. Apoptosis is designed to eliminate unwanted cells during the development of the embryo and in various physiological processes. It also occurs under pathological conditions, where it is sometimes accompanied by necrosis.