

Difference Between Reversible and Irreversible Cell Injury

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Key Difference – Reversible vs Irreversible Cell Injury

Cells are the main functional and structural units of living organisms. Cells undergo many [adaptations](#) in response to different environmental, physiological and chemical stimuli. They have the ability to resist these different external and internal stress stimuli. When the stress on cells is so severe that they are no longer able to adapt, or when they are exposed to damaging agents, cells get injured. Cell injury can be mainly divided into two types: reversible and irreversible cell injury. **Reversible cell injury results in morphological and cellular changes that could be reversed if the stress is taken off. Irreversible cell injury results in complete cell death and normal cellular conditions cannot be achieved even if the stress is relieved.** This is the key difference between Reversible and Irreversible Cell Injury.

What is Reversible Cell Injury?

Reversible cell injury occurs when the damaged cell is capable of returning to its normal physiological state when the stress is removed from the cell. Low levels of stress can cause reversible cell injury; exceeding the threshold results in irreversible injury.

There are three main results of reversible cell injury;

1. Depleted resources of [ATP](#) in the cell which is due to decreased rate of [oxidative phosphorylation](#) resulting from oxidative stress.
2. Hydropic cellular swelling due to osmotic imbalances caused by ions and other chemicals.
3. [Organelles](#) with subtle alterations which will not affect the cellular functions.

The above three outcomes of reversible cell injury can be brought back to the normal by providing the necessary [homeostatic](#) mechanisms which will remove the respective stresses on the cells.

A cell undergoing reversible cell injury can be recognized by cellular swelling and the changes in the lipid concentrations in cells. Cellular swelling occurs in response to ion imbalances or due to mechanical injury caused on the [plasma membrane](#). This will affect the transport process across membranes resulting in cellular injury. Alterations of lipids also take place as a result of reversible cell injury and predominantly, accumulation of lipids can be observed during reversible cell injury.

What is Irreversible Cell Injury?

Irreversible cell injury takes place when a cell is subjected to intense stress. Irreversible cell injury results in cell death. This is either caused by apoptosis or necrosis. [Apoptosis](#) is the controlled cell death which takes place in response to cell aging. [Necrosis](#) is the process of cell death taking place due to a physical, chemical or a biological agent that causes irreversible cell injury.

Irreversible cell injury is characterized by the following features;

1. Extensive physical damage to the cells, especially organelles like [mitochondria or chloroplast](#)
2. Complete ATP depletion
3. Influx of calcium and loss of calcium homeostasis
4. Accumulation of oxygen free radicals
5. DNA damage.

Factors like [hypoxia/ischemia](#), extreme temperatures, radiation, chemical agents, infectious agents, immune responses, nutrition, and genetics are causes for irreversible cell injuries.

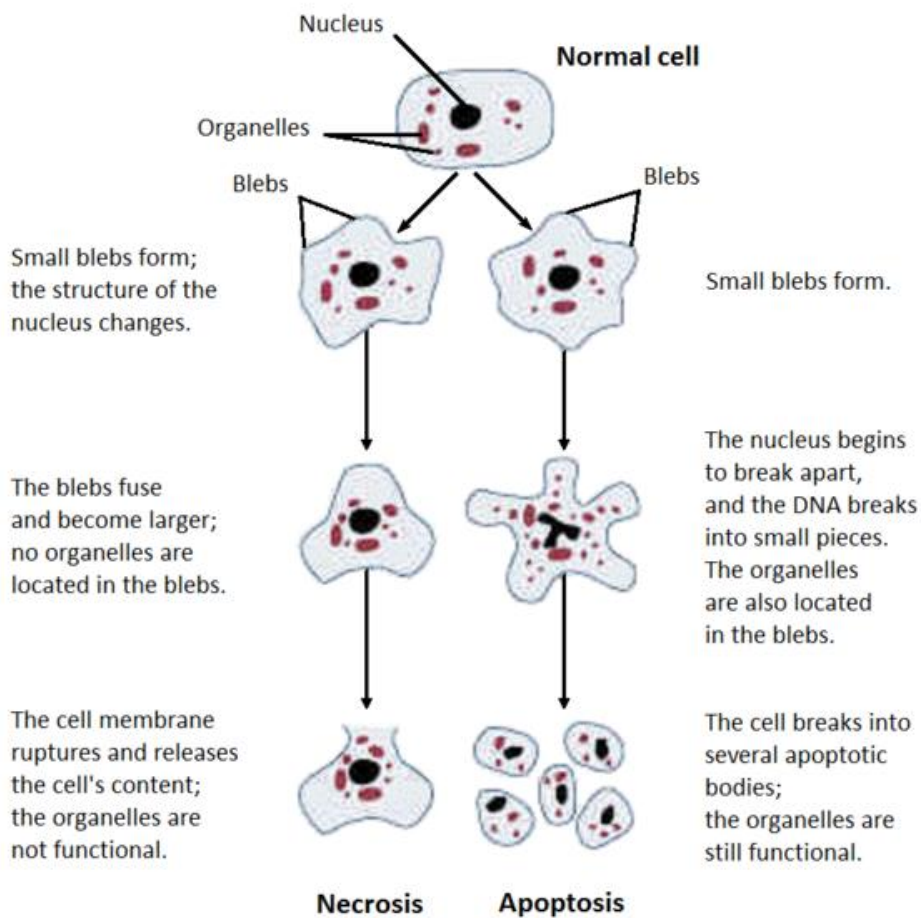


Figure 02: Irreversible Cell Injury

What are the similarities between Reversible and Irreversible Cell Injury?

- Both reversible and irreversible cell injuries occur when stress acts upon cells.
- Both are caused by chemical, physical or biological agents.
- In both cases, abnormal cellular responses arise.

What is the difference between Reversible and Irreversible Cell Injury?

Reversible vs Irreversible Cell Injury

Reversible cell injury results in morphological and cellular changes

Irreversible cell injury results in complete cell

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| that could reverse if the stress is taken off the cell. | death. |
| Ability to Return to Normal State | |
| Cells can return to the normal cellular state when the stress is taken off. | Cells cannot return to the normal state even if the stress is taken off. |
| Cause | |
| Depleted resources of ATP, cellular swelling and minute changes in cellular organelles result in reversible cell injuries. | Complete depletion of ATP, mechanical cellular damage, DNA damage, complete disrupt of calcium homeostasis, and cell death result in irreversible cell injuries. |
| Special Mechanisms | |
| Deposition of fat or imbalances in ionic concentrations is involved in reversible cell injuries. | Apoptosis or necrosis occurs in irreversible cell injuries. |

Summary – Reversible vs Irreversible Cell Injury

Cellular injury and mechanisms involved in this process are widely studied topics that explore the causes and causative agents of diseases. By studying them, new drug targets and therapeutic methods can be elucidated. This will increase the accuracy and the specificity of the treatment. Reversible and irreversible injury are the two main types of cell injury. Both these mechanisms will alter the cellular conditions and the physiological processes. This result in abnormal outcomes leading to cellular injury which can either be reversed or complete cell death. Reversible cell injuries can be reversed back to normal while irreversible cell injuries cannot reverse back to normal. This is the difference between reversible and irreversible cell injury.

References:

1. “Mechanism of Irreversible Cell Injury.” The Art Of Medicine, 10 June 2015, [Available here](#). Accessed 12 Sept. 2017.
2. “Pathologic Cell Injury and Cell Death I – Mechanism of Reversible Cell Injuries.” The Art Of Medicine, 28 May 2015, [Available here](#). Accessed 12 Sept. 2017

Image Courtesy:

1. "Structural changes of cells undergoing necrosis or apoptosis" By National institute on alcohol abuse and alcoholism (NIAAA) – File:Structural changes of cells undergoing necrosis or apoptosis.gif; (pubs.niaaa.nih.gov), (Public Domain) via [Commons Wikimedia](#)

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