

Cellular Adaptations, Injury, and Death

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1. Introduction

- Cells respond to stress through adaptation, injury, or death depending on severity.
- Understanding these responses explains how tissues react to harmful stimuli.

2. Cellular Adaptations

- **Hypertrophy:** increase in cell size, as in enlarged heart muscle.
- **Hyperplasia:** increase in cell number, such as in endometrial growth.
- **Atrophy and metaplasia:** shrinkage of cells, or change from one cell type to another.

3. Causes of Cell Injury

- Hypoxia and ischemia from reduced oxygen or blood supply.
- Physical, chemical, and infectious agents.
- Immune reactions, genetic defects, and nutritional imbalance.

4. Reversible vs Irreversible Injury

- **Reversible injury:** cell swelling and fatty change that recover if stress is removed.
- Irreversible injury follows severe membrane damage and loss of energy production.
- Hallmarks include mitochondrial dysfunction and calcium influx.

5. Cell Death

- **Necrosis:** uncontrolled death with inflammation, such as coagulative or liquefactive types.
- **Apoptosis:** programmed, orderly death without inflammation.
- Recognizing the pattern aids diagnosis of underlying disease.