PATHOPHYSIOLOGY – BP204T

UNIT : 1

CLASS:2

TOPIC: Cell swelling due to intracellular accumulation

Cell swelling due to intracellular accumulation typically refers to a form of **reversible cell injury** where water, ions, or other substances accumulate inside the cell, leading to an increase in cell volume. This is often an early and mild manifestation of cellular injury.

Causes of Cell Swelling from Intracellular Accumulation:

1. **Hypoxia/Ischemia**:
   - Leads to failure of ATP-dependent ion pumps (like Na^+/K^+-ATPase), resulting in sodium and water influx into the cell.
   - Cells swell due to osmotic imbalance.
2. **Toxin Exposure**:
   - Impairs membrane integrity or ion pump function, leading to water influx.
3. **Infections**:
   - Viruses or bacteria can disrupt cellular homeostasis and cause swelling.
4. **Metabolic Derangements**:
   - Defects in lipid, protein, or carbohydrate metabolism can cause the accumulation of abnormal substances.

Types of Intracellular Accumulation Causing Swelling:

- **Water (Hydropic change)**:
  - The most common and early change in reversible injury.
  - Appears as vacuolar degeneration under the microscope.
- **Ions (Na^+, Ca^{2+})**:
  - Sodium influx causes water to follow osmotically.
  - Calcium influx can activate enzymes that further damage the cell.

- **Lipids, Proteins, Glycogen** (in specific diseases):
  - While not always causing swelling per se, excessive accumulation can distort or expand the cell.

Microscopic Appearance:

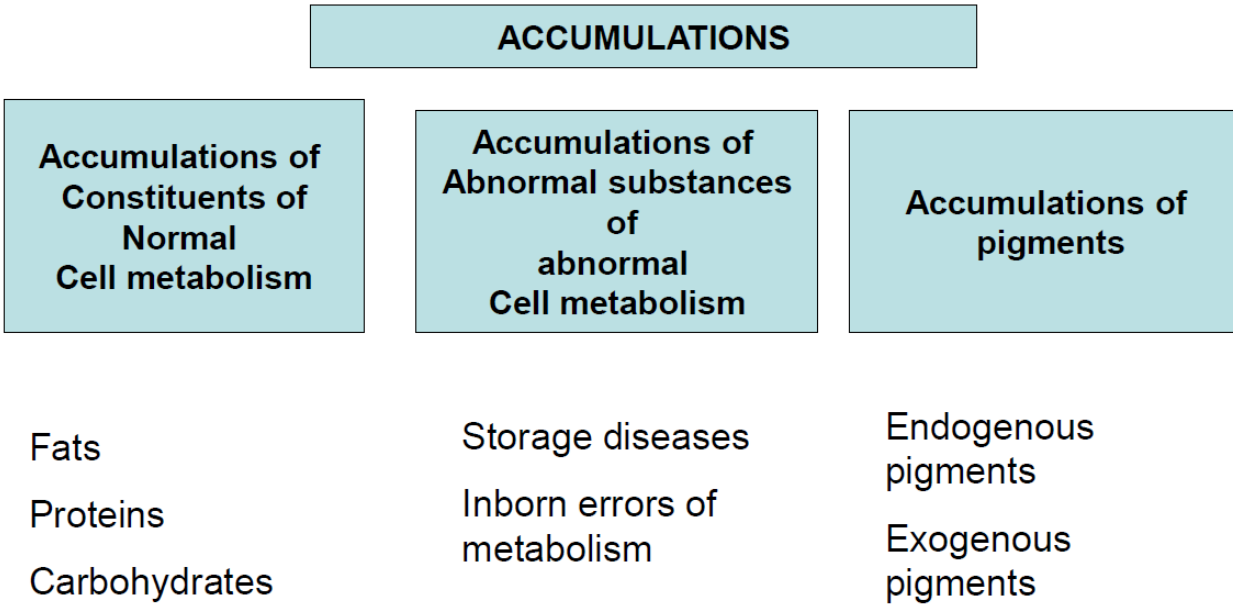
- Enlarged, pale cytoplasm with small vacuoles.
- The nucleus remains intact in reversible injury.

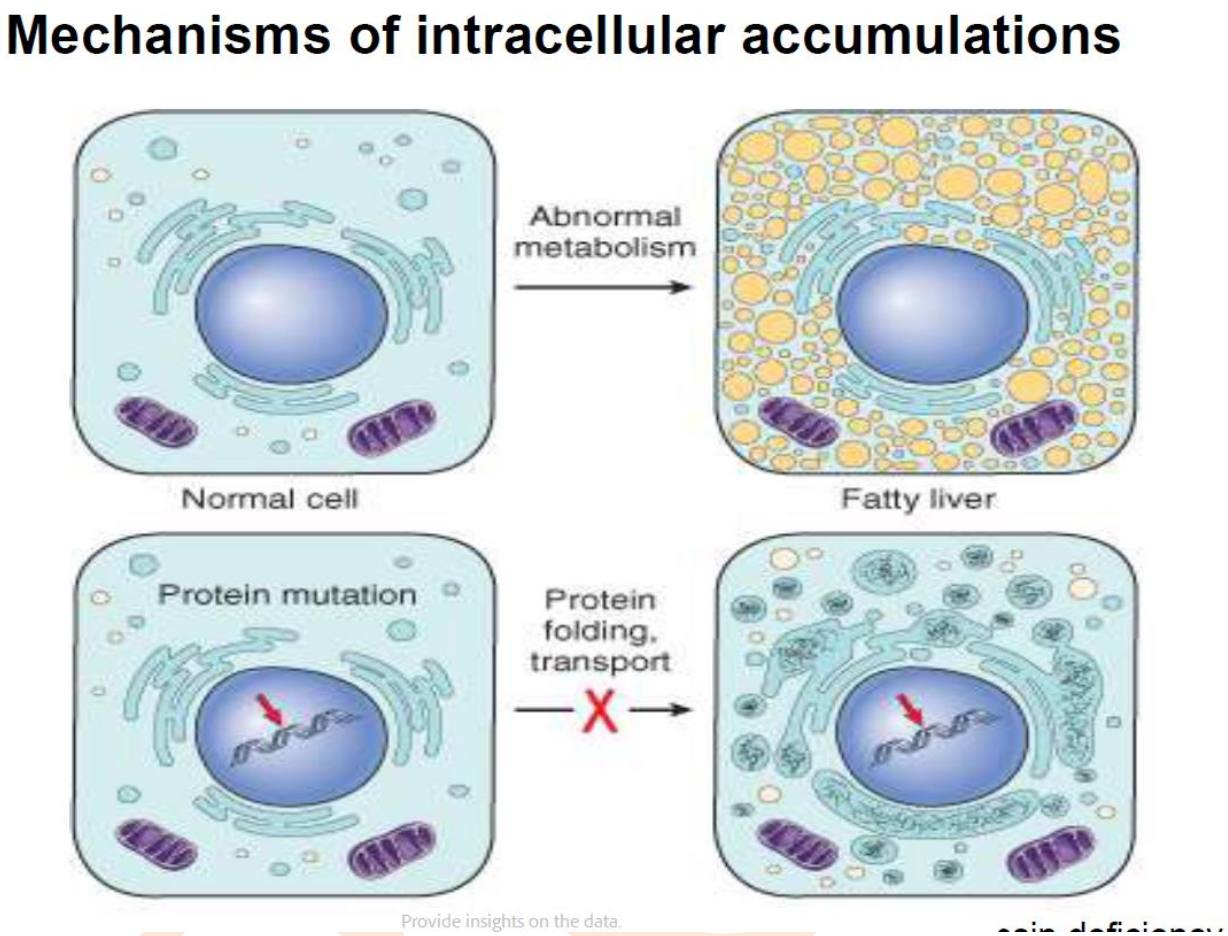
Intracellular accumulations

• Manifestation of metabolic derangement

• Accumulation may be transient & reversible or permanent. Effects: range from harmless to toxic

- **• Three categories**





FATTY CHANGE

- Steatosis
- Fatty metamorphosis
- Intracellular accumulation of neutral fat(triglycerides) within the parenchymal cells.
- Common in liver
- Can occur in heart, skeletal muscle and kidneys.

Causes of fatty liver

- **- ALCHOL ABUSE**
- - DIABETES MELLITUS
- - OBESITY
- - PROTIEN MALNUTRION (starvation)
- -DRUGS/TOXINS

• -ANOXIA
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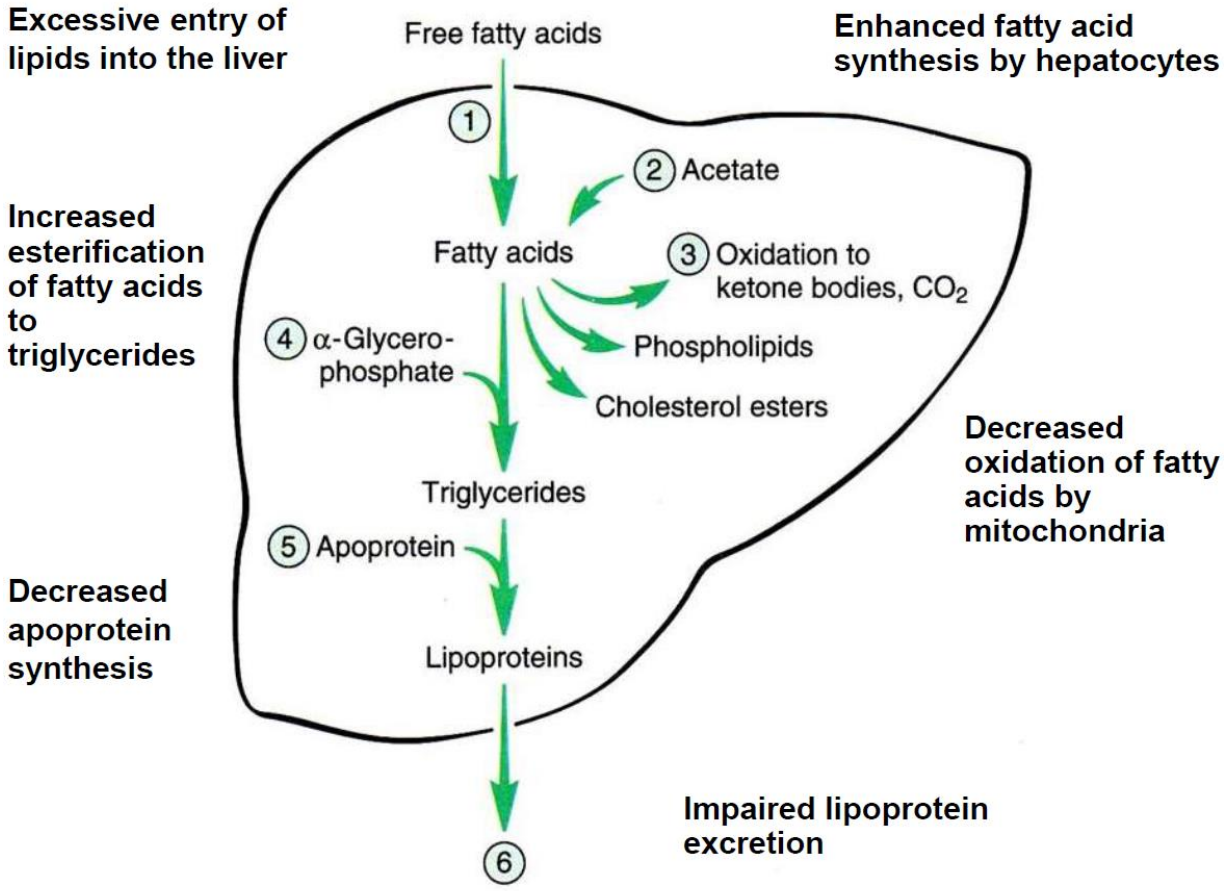


Intracellular Accumulation of Proteins

Excesses exceeding capacity of cell to metabolize	**Synthesis and secretion of excessive protein**	**Defects in protein folding**, rendering them vulnerable to intracellular aggregation:
ephrotic syndrome, efined by 24 hr. ine protein > 3.5 ms.	Monoclonal immunoglobulins in serum and/or urine, due to bone marrow containing excess numbers of neoplastic plasma cells Eg: Myeloma	Inherited metabolic disease, PiZZ genotype (1/7000 persons), resulting in < 10% normal plasma levels of alpha 1 - antitrypsin with accumulations of protein in hepatocytes
manifested as toplasmic protein oplets in renal bular epithelium		

Intracellular Accumulation of Proteins

• Primarily in epithelial cells of the proximal convoluted tubules of the kidney and in plasma cells
• In the kidney, this excessive accumulation occurs subsequent to leakage of proteins from glomeruli into the glomerular filtrate
• Plasma cells – RUSSEL BODIES
• Alpha 1 antitrypsin deficiency
• Mallory body or alcholic hyalin

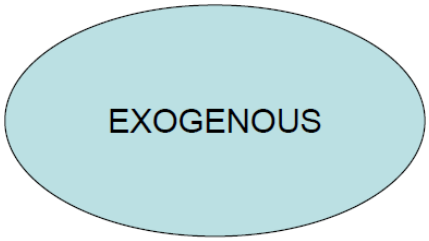
Intracellular Accumulation of Glycogen

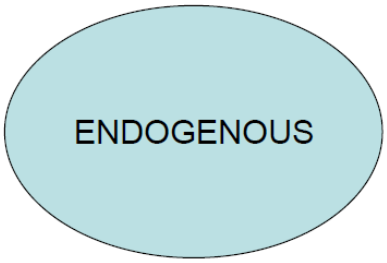
• **Glycogen Infiltration** and **Glycogen Storage**
• Glycogen appears as clear vacuoles in the cytoplasm of cells
• Hyperglycemia
• Epithelial cells of the distal portion of the proximal convoluted tubule and in the loop of Henle in the kidney
• Leukocytes within inflamed or necrotic tissue
• Liver

• Cardiac muscle fibers

Intra cellular accumulations
Pigments

Pigments are colored substances, some of which are normal constituents of cells (e.g., melanin), whereas others are abnormal and accumulate in cells only under special circumstances
– Exogenous
– Endogenous





1. Carbon – coal dust
   - Anthracosis
   - Coal workers pneumoconiosis
2. Tattooing
   - India ink, carbon
3. Ingested
   - Argyria : silver
   - Lead
   - carotenemia

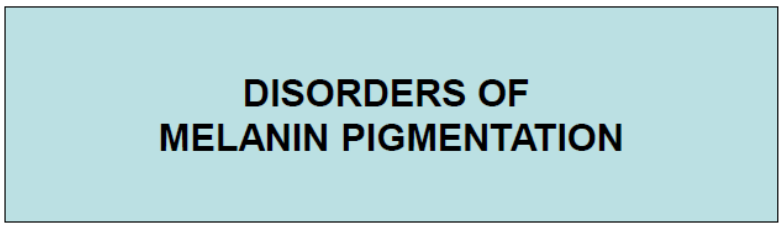
1. Lipofuschin
2. Melanin
3. Hemosiderin

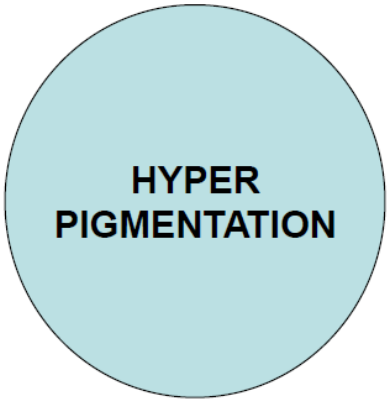
Exogenous pigments
Carbon (anthracosis)
Coal dust (pneumoconiosis)

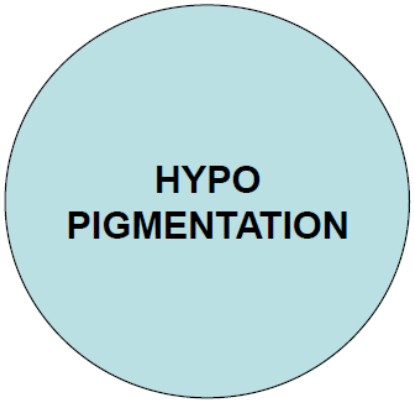
Lung: pick up by alveolar macrophages
regional lymph nods
blackening the tissues of the lungs
(anthracosis)

Lipofuschin
• Insoluble pigment, also known as **lipochrome** or **wear-and-tear pigment**
• Composed of polymers of lipids and phospholipids in complex with protein
• Not injurious to the cell or its functions
• Telltale sign of free radical injury and lipid Peroxidation

In sections it appears as a yellow-brown, finely granular cytoplasmic, often perinuclear, pigment
• Seen in liver and heart of ageing patients
• Patients with severe malnutrition
• Cancer cachexia

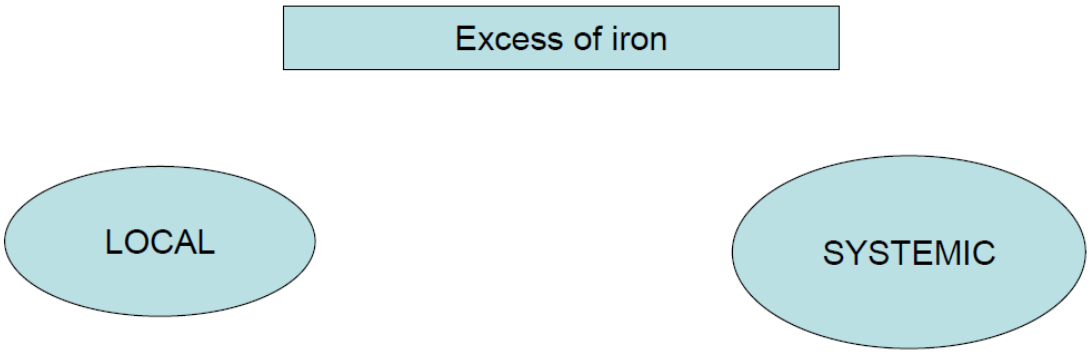






Hemosiderin

- Hemoglobin-derived, golden yellow-to-brown, granular or crystalline pigment
- Major storage forms of iron
- Hemosiderin pigment represents aggregates of ferritin micelles
- Small amounts of hemosiderin can be seen in the mononuclear phagocytes of the bone marrow, spleen, and liver, which are actively engaged in red cell breakdown.



Common bruise

1. Acquired Hemosiderosis
   - Hemolytic disorders
   - Blood transfusion
   - Iatrogenic
2. Heriditary hemochromatosis
   - Increased absorption
3. Excessive dietary intake.