



Cell Injury:

If adaptive capability of the cell is exceeded, cell injury occur.

Types of Cell injury:

1- Reversible cell injury: the morphological and structural changes are reversible, if the damaging stimulus is removed.

2- Irreversible cell injury and cell death: state in which the cell cannot recover (point of no return), and it's of two types (1- necrosis , 2- apoptosis).

- The ability of the cell or organ to tolerate injury depends on:

The severity, duration, and type of insult, as well as the adaptive capacity of the tissue

Causes of cell injury:

1-Hypoxia: deficiency of oxygen, due to (cardio-respiratory failure, anemia, and carbon monoxide poisoning).

2-Ischemia: decrease blood supply to the tissue either due to arterial block or reduced venous drainage.

3-Physical agents: burn, deep cold, mechanical trauma, radiation, electric shock.

4-Chemicals and drugs: poisons like cyanide, insecticides, drugs.

5-Microbiologic Agents: bacteria, parasites, viruses, and fungi

6-Immunologic Reactions: such as anaphylaxis

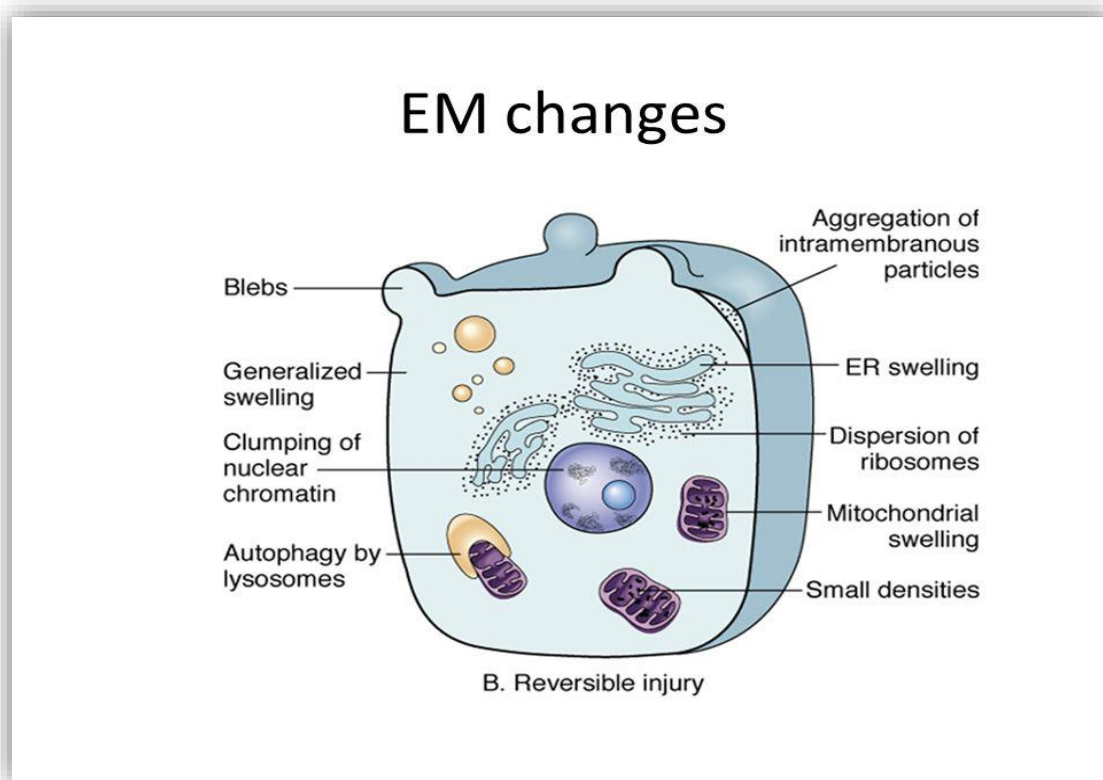
7-Genetic defects: Sickle cell anemia causing red blood cell injury.

8-Nutritional imbalances: vitamin deficiencies, excess lipid intake.

9-Aging.

The intracellular changes associated with reversible injury include

1. plasma membrane alterations such as blebbing, blunting, or distortion of microvilli, and loosening of intercellular attachments;
2. mitochondrial changes such as swelling
3. dilation of the ER with detachment of ribosomes
4. nuclear alterations, with clumping of chromatin. The cytoplasm may contain phospholipid masses, called myelin figures, which are derived from damaged cellular membranes.



Reversible cell injury are included:

1. Hydropic change (cloudy swelling, or vacuolar degeneration)
2. Fatty change



Hydropic Change

Hydropic change means accumulation of water within the cytoplasm of the cell. Other synonyms used are **cloudy swelling** (for gross appearance of the affected organ) and **vacuolar degeneration** (due to cytoplasmic vacuolation).

ETIOLOGY.

This is the commonest and earliest form of cell injury from almost all causes. The common causes include acute and subacute cell injury from various etiologic agents such as bacterial toxins, chemicals, poisons, burns, high fever , etc.

PATHOGENESIS.

Cloudy swelling results from impaired regulation of sodium and potassium at the level of cell membrane. This results in intracellular accumulation of sodium and escape of potassium. This, in turn, leads to rapid flow of water into the cell to maintain iso-osmotic conditions and hence cellular swelling occurs. Hydropic swelling is an entirely reversible change upon removal of the injurious agent.

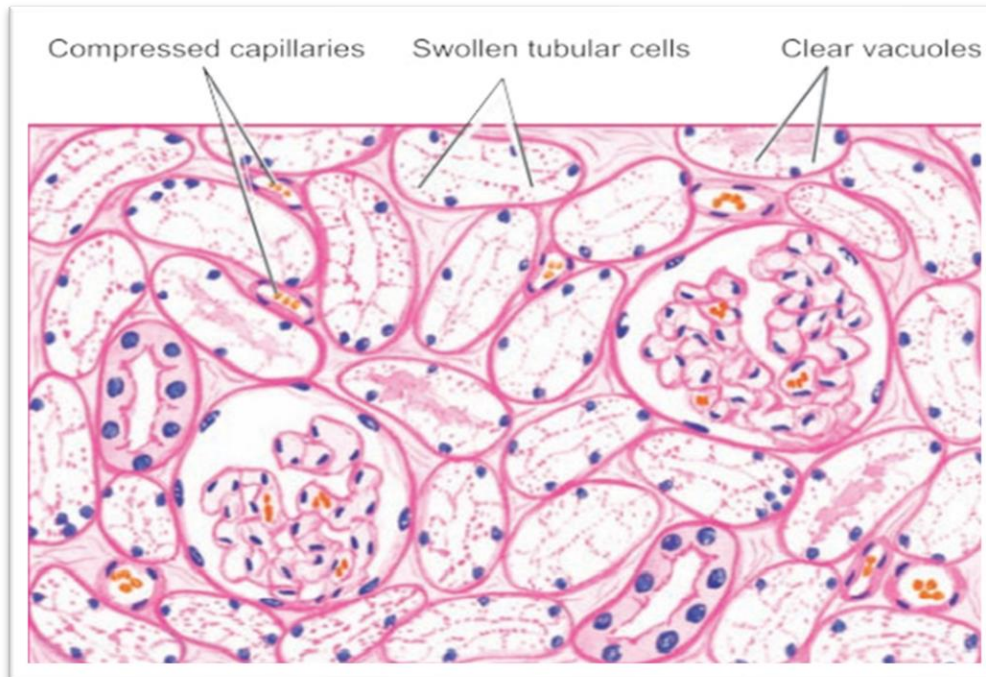
MORPHOLOGIC FEATURES.

Grossly, the affected organ such as kidney, liver, pancreas, or heart muscle is enlarged due to swelling.

Microscopically, it is characterised by the following

- i) The cells are swollen and the microvasculature compressed.
- ii) Small clear vacuoles are seen in the cells and hence the term vacuolar degeneration. These vacuoles represent distended cisternae of the endoplasmic reticulum.
- iii) Small cytoplasmic blebs may be seen.

iv) The nucleus may appear pale



Hydropic change kidney. The tubular epithelial cells are distended with cytoplasmic vacuoles while the interstitial vasculature is compressed. The nuclei of affected tubules are pale

FATTY CHANGE (STEATOSIS)

Fatty change, steatosis is the intracellular accumulation of neutral fat within parenchymal cells. It includes the older, now abandoned, terms of fatty degeneration and fatty infiltration because fatty change neither necessarily involves degeneration nor infiltration. The deposit is in the cytosol and represents an absolute increase in the intracellular lipids. It is especially common in the liver but may occur in other non-fatty tissues like the heart, skeletal muscle, kidneys and other organs

Fatty Liver

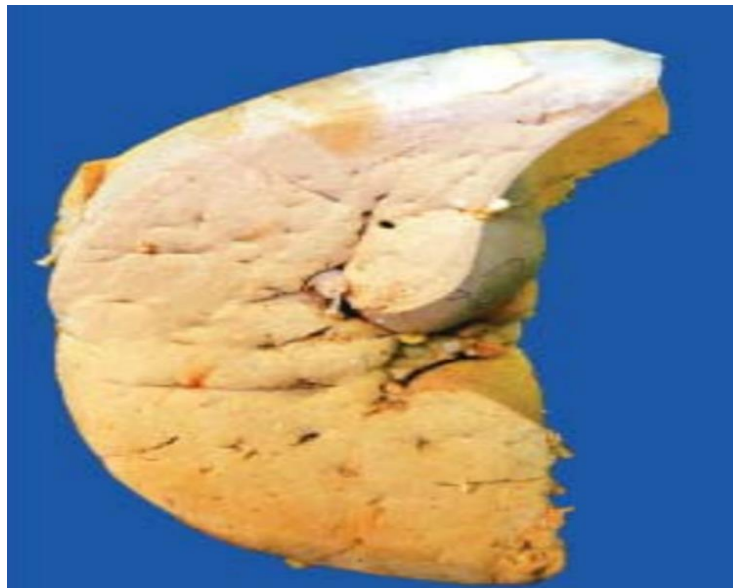
Liver is the commonest site for accumulation of fat because it plays central role in fat metabolism. Depending upon the cause and amount of accumulation, fatty change may be mild and reversible, or severe producing irreversible cell injury and cell death.

ETIOLOGY. Fatty change in the liver may result from one of the two types of causes: 1. Conditions with excess fat (hyperlipidameia).
2. Liver cell damage.

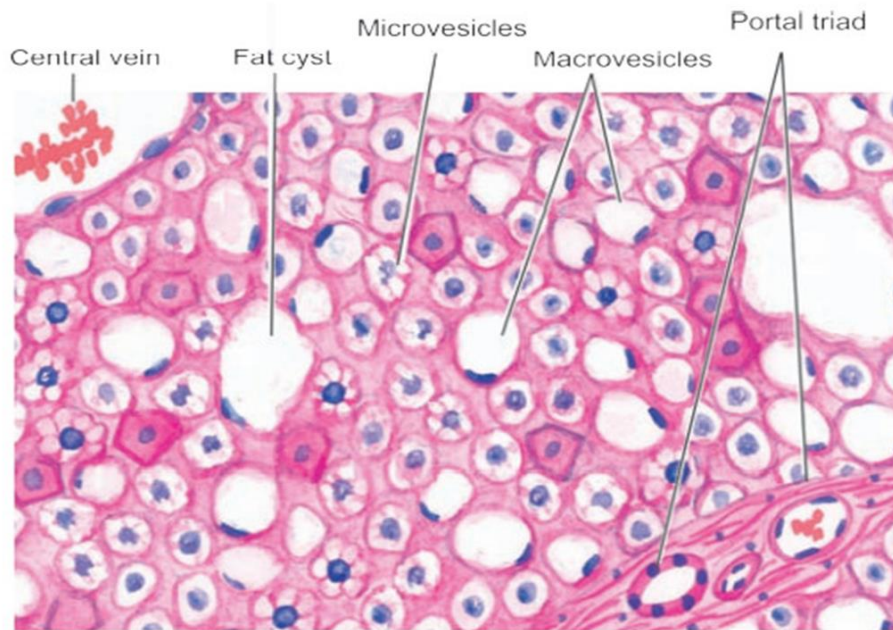
MORPHOLOGIC FEATURES

Grossly, the liver in fatty change is enlarged with a tense, glistening capsule and rounded margins. The cut surface bulges slightly and is pale-yellow to yellow and is greasy to touch

Microscopically, characteristic feature is the presence of numerous lipid vacuoles in the cytoplasm of hepatocytes.



Fatty liver. Sectioned slice of the liver shows pale yellow parenchyma with rounded borders



Fatty liver. Many of the hepatocytes are distended with large fat vacuoles pushing the nuclei to the periphery (macrovesicles), while others show multiple small vacuoles in the cytoplasm (microvesicles)