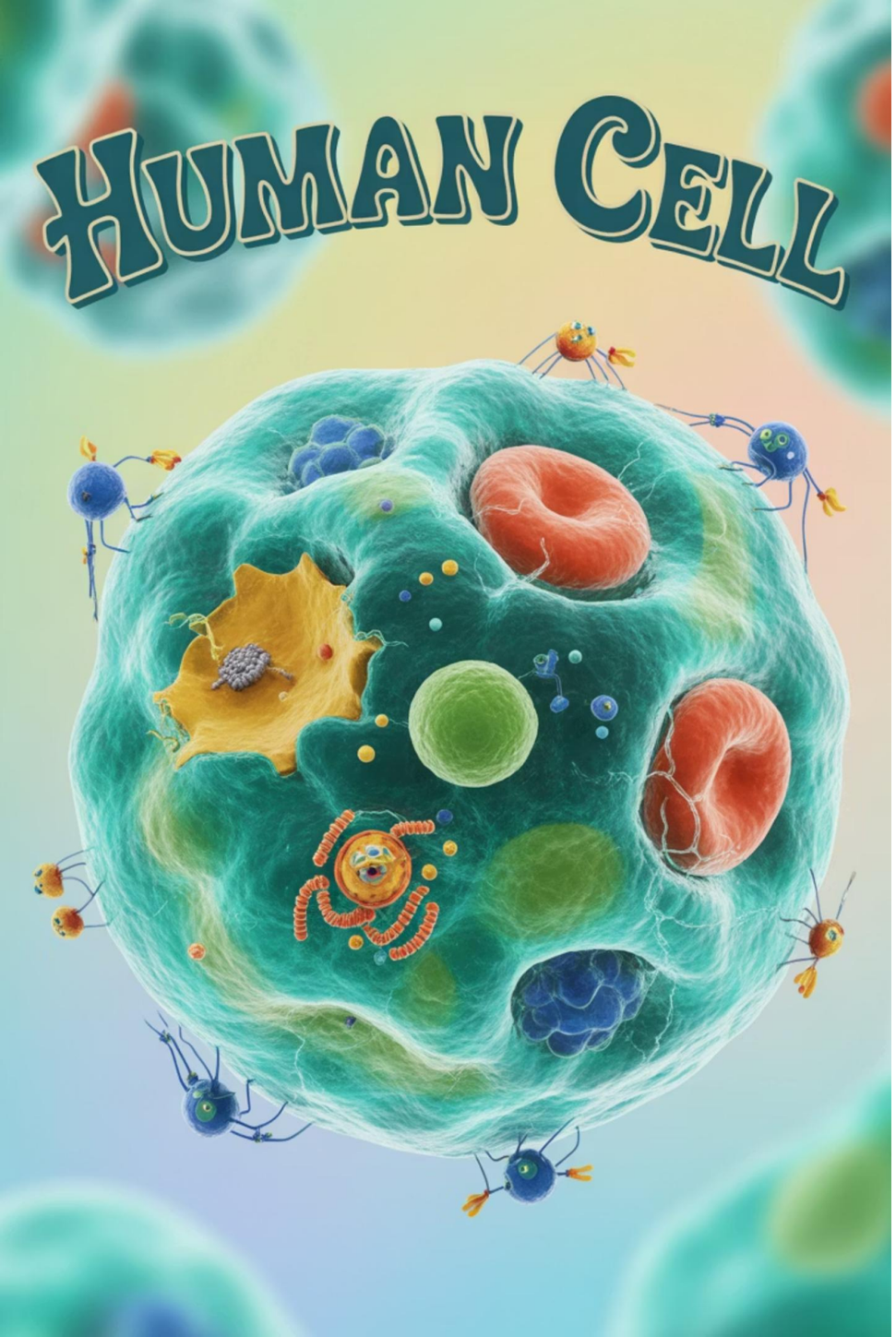
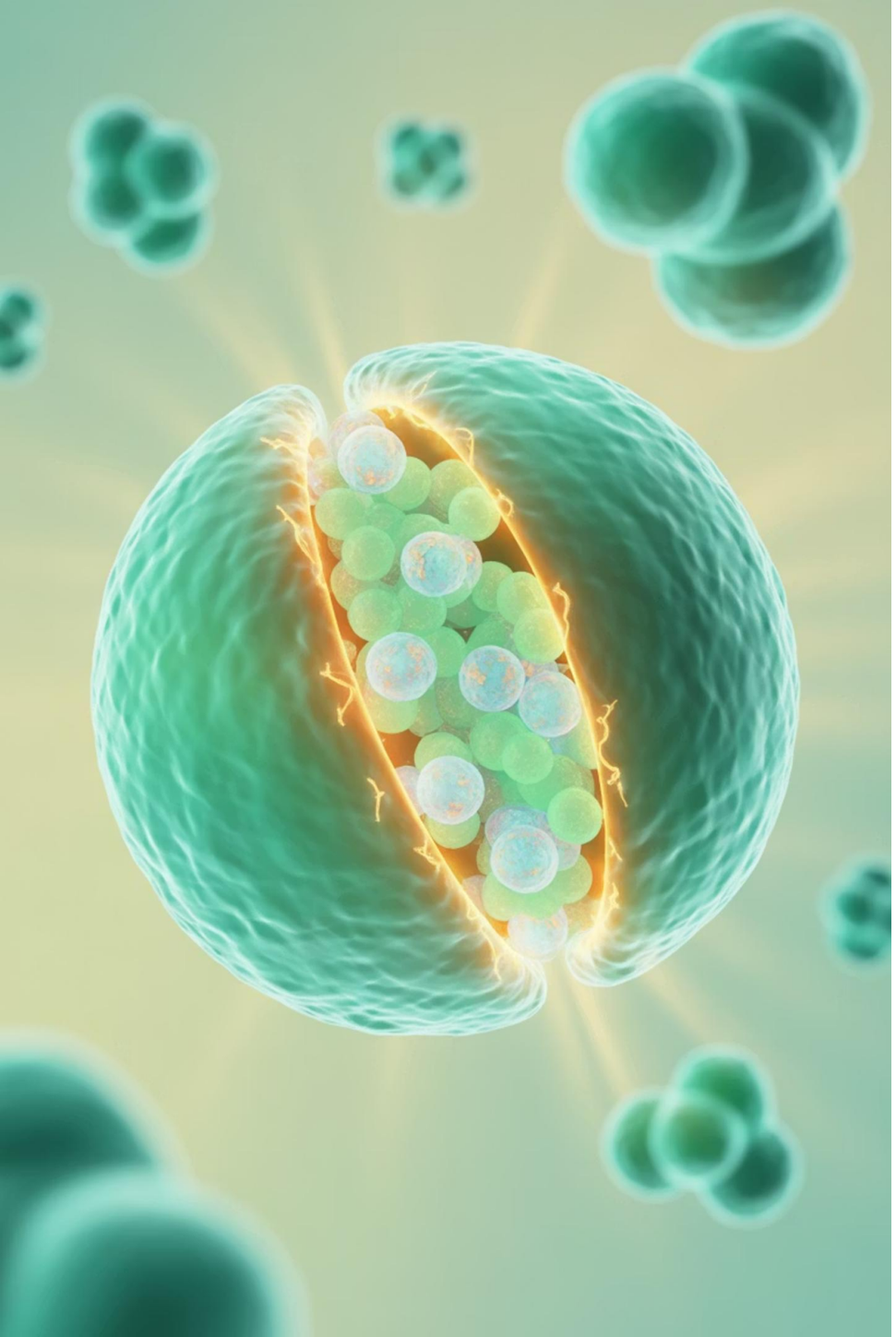


Cell Injury

Dr. Shaymaa Adil



Understanding Cell Injury

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

Types of Cell Injury

Reversible Cell Injury

The morphological and structural changes are reversible, if the damaging stimulus is removed.

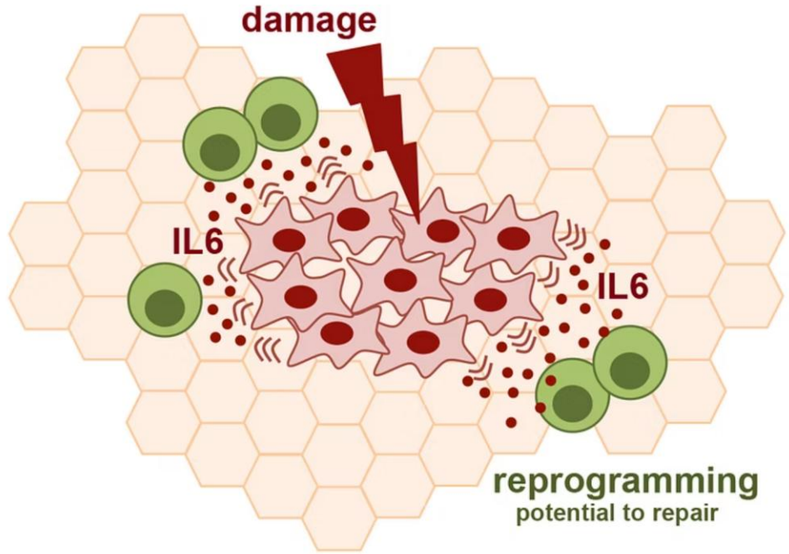
Irreversible Cell Injury and Cell Death

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

Factors Affecting Cell Tolerance

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).

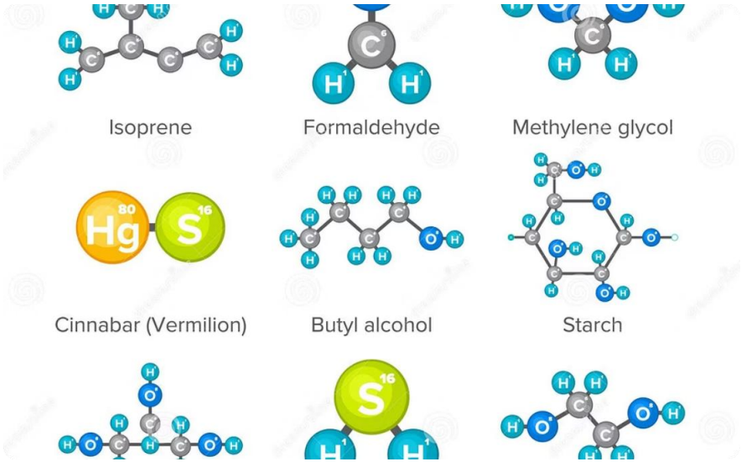
2 Ischemia

Decrease blood supply to the tissue either due to arterial block or reduced venous drainage.

3 Physical Agents

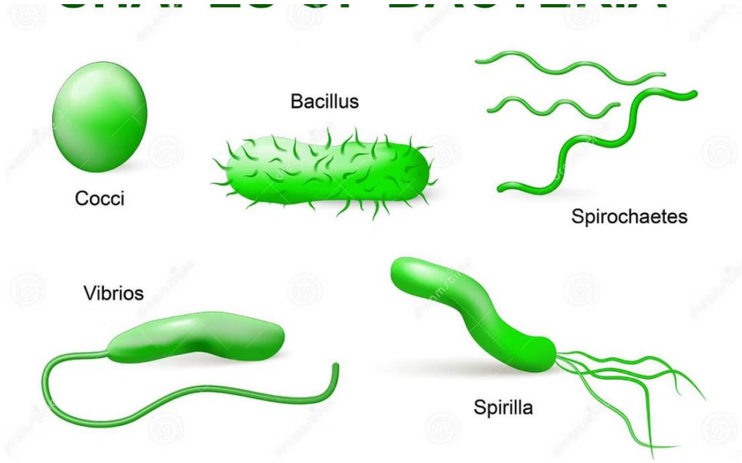
Burn, deep cold, mechanical trauma, radiation, electric shock.

Additional Causes of Cell Injury



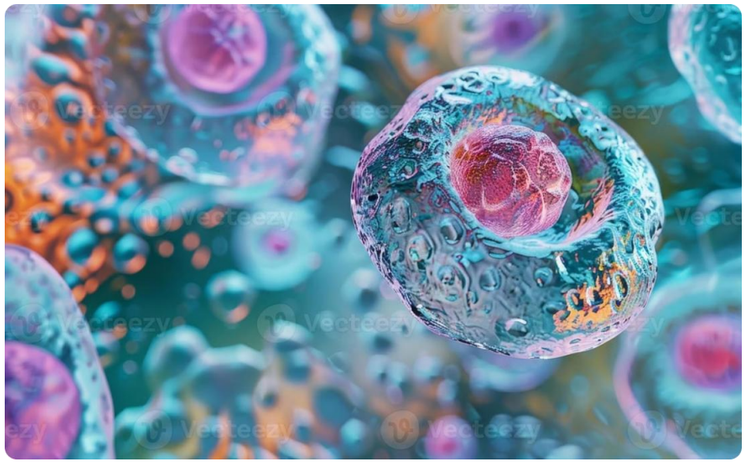
Chemicals and Drugs

Poisons like cyanide, insecticides, drugs.



Microbiologic Agents

Bacteria, parasites, viruses, and fungi



Immunologic Reactions

Such as anaphylaxis

Final Categories of Cell Injury Causes

01

Genetic Defects

Sickle cell anemia causing red blood cell injury.

02

Nutritional Imbalances

Vitamin deficiencies, excess lipid intake.

03

Aging

Natural cellular deterioration over time.

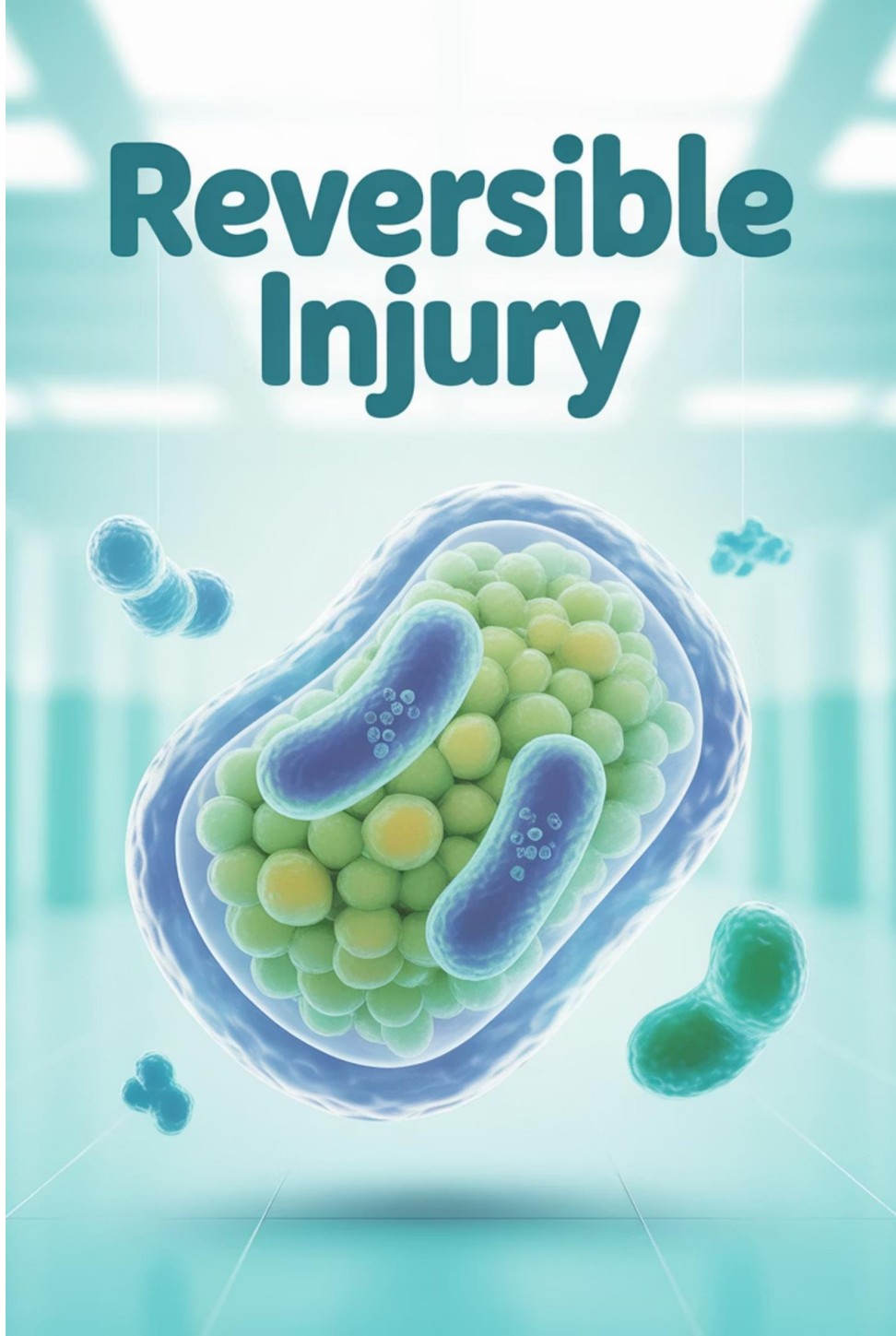
The Intracellular Changes Associated with Reversible Injury Include

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

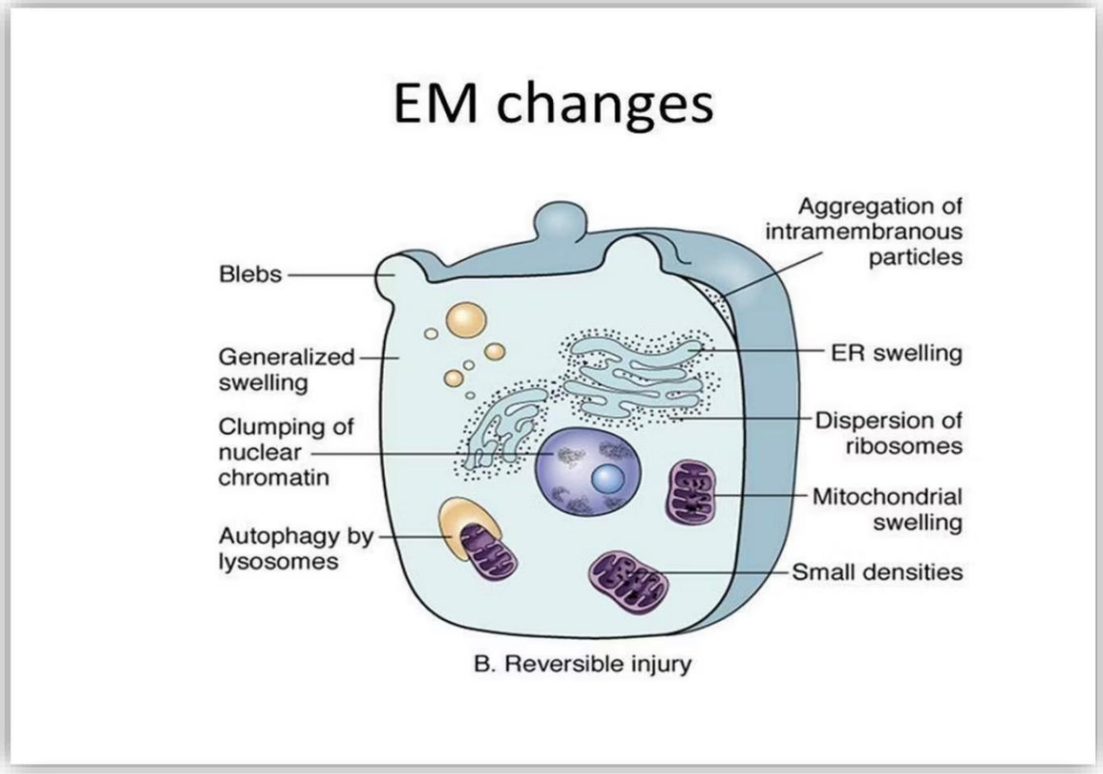
4. nuclear alterations, with clumping of chromatin. The cytoplasm may contain phospholipid masses, called myelin figures, which are derived from damaged cellular membranes.

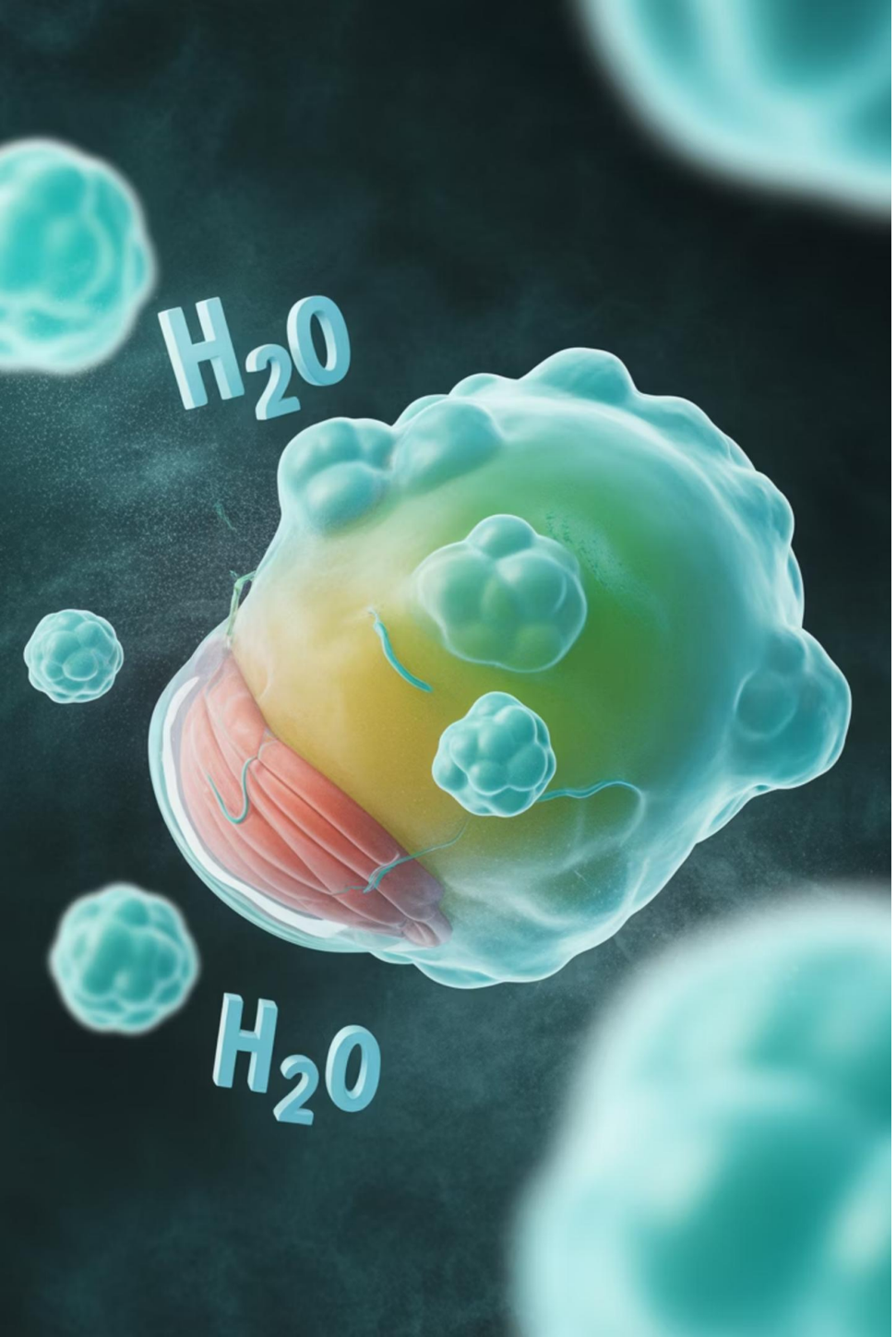


Types of Reversible Cell Injury

Reversible cell injury are included:

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





Hydropic Change Definition

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 and Pathogenesis of Hydropic Change

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 of Hydropic Change

MORPHOLOGIC FEATURES

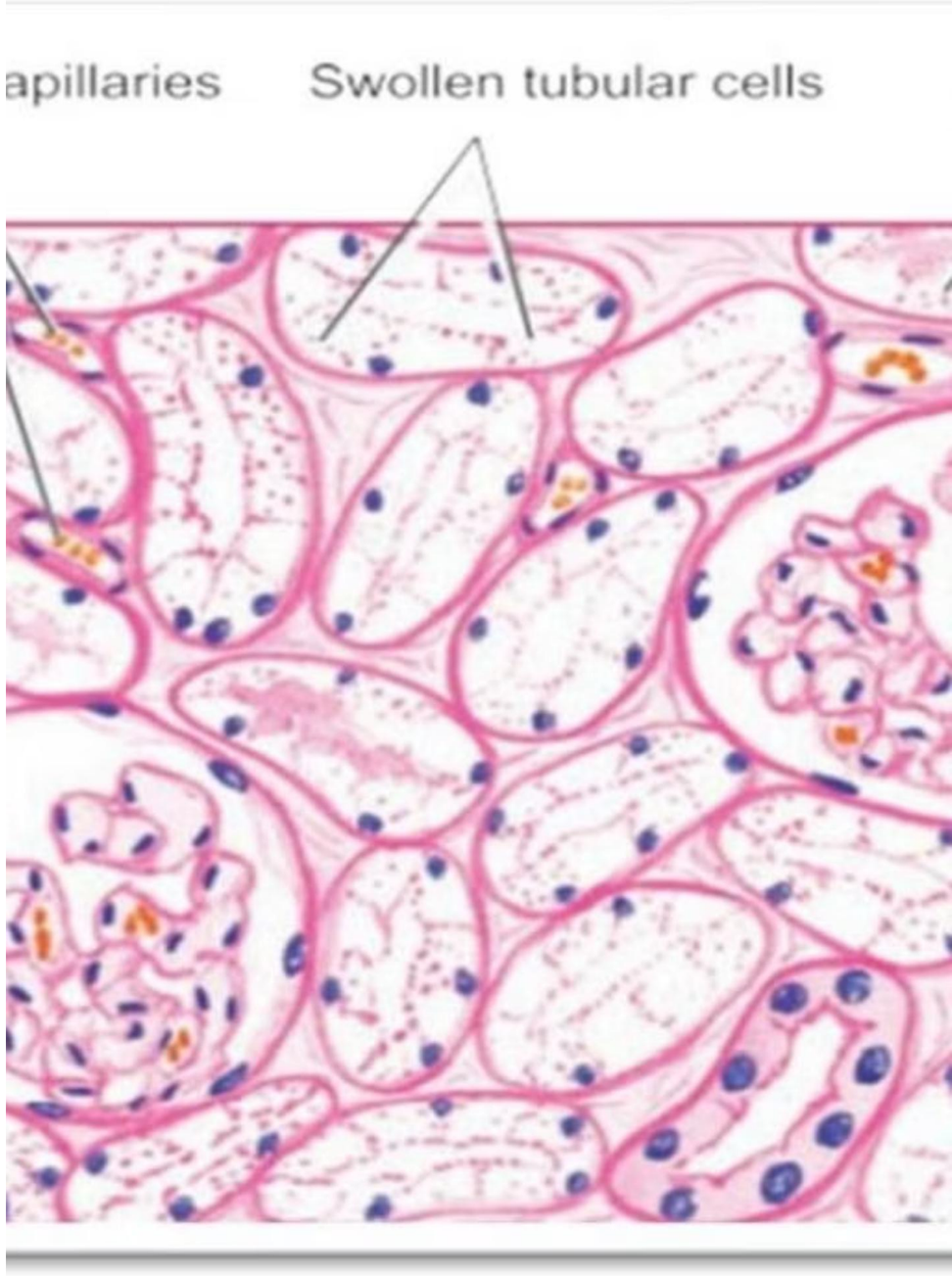
Grossly, the affected organ such as kidney, liver, pancreas, or heart muscle is enlarged due to swelling.

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.

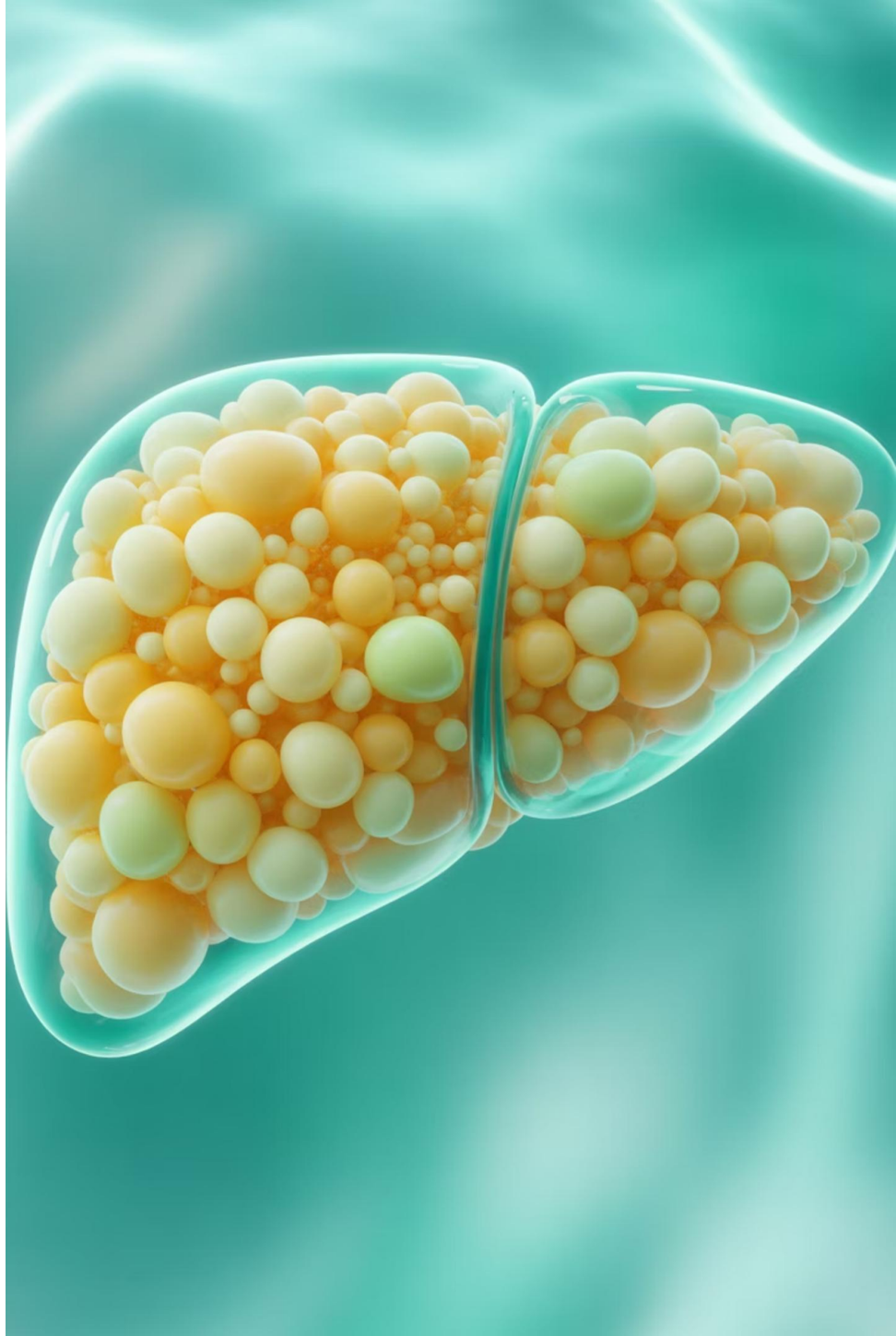
Hydropic Change in Kidney

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

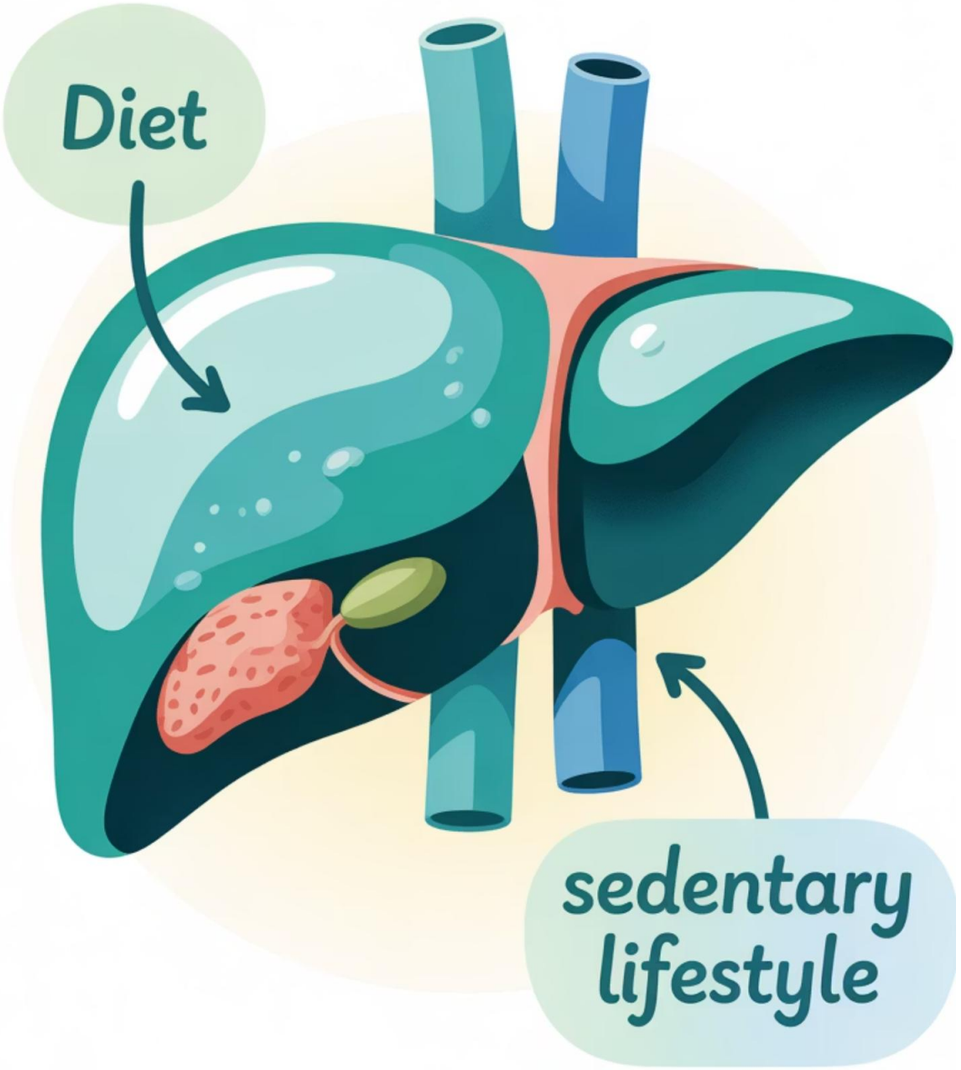


Fatty Change (Steatosis)

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 Disease



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.

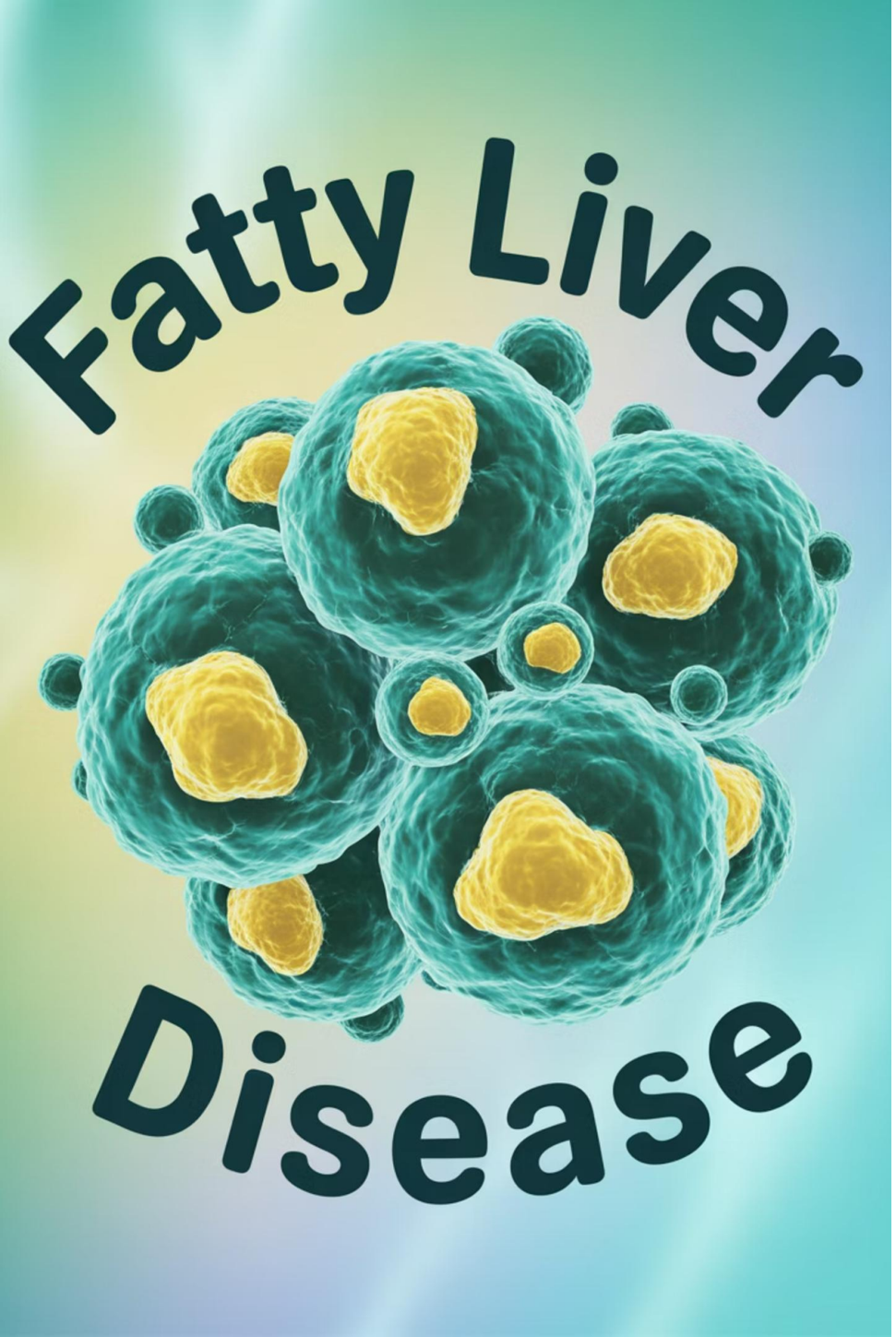
Morphologic Features of Fatty Liver

MORPHOLOGIC FEATURES

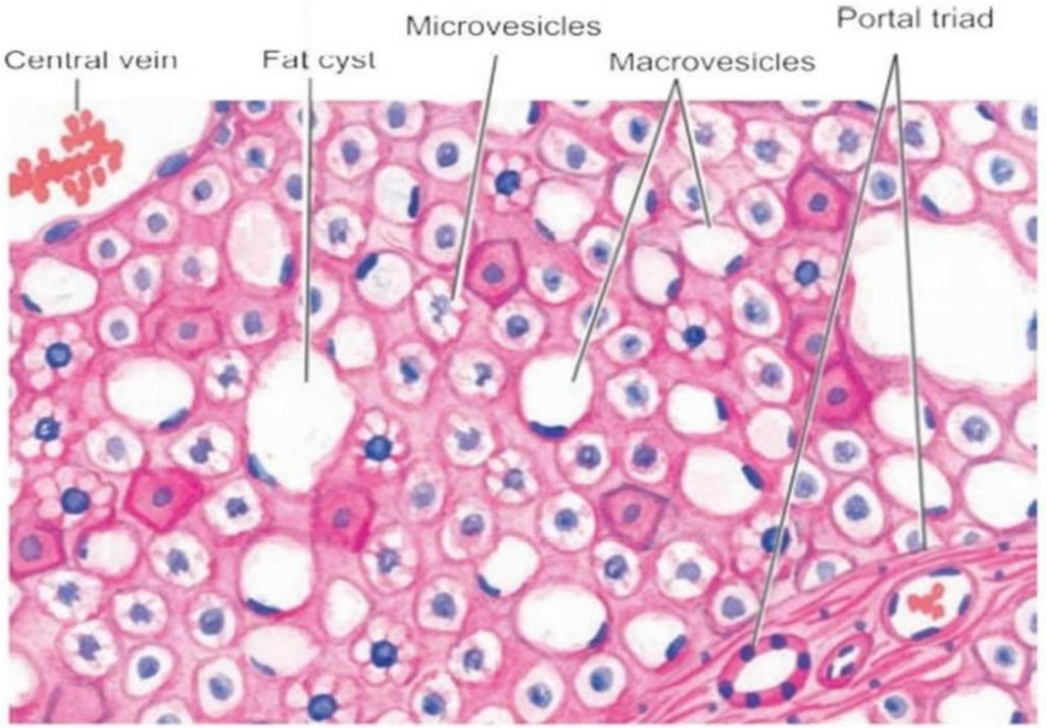
Grossly, the liver in fatty change is enlarged with a tense, glistening capsule and rounded margins. The cut surface bulges slightly and is pale-yellow to yellow and is greasy to touch

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



Microscopic Appearance of Fatty Liver



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)