DISTURBANCES IN CELL METABOLISM

- Cloudy Swelling
- Hydropic Degeneration
- Mucinous Degeneration
- Mucoid Degeneration
- Psuedomucin
- Amyloid Infiltration
- Hyaline Degeneration
- Fatty Changes
- Glycogen Infiltration
- Model Questions
CLOUDY SWELLING
Swelling of cells occur with hazy appearance due to a mild injury. The cells take more water due to defect in sodium pump leading to swollen mitochondria which gives granular cytoplasmic appearance. It is the first reaction of cell to a mildest injury. Cloudy swelling is a reversible reaction (Fig. 6.1 & 6.2).

Etiology
- Can be caused by any mildest injury.
- Any factor causing interference with metabolism of the cell like bacterial toxins, fever, diabetes, circulatory disturbances etc.

Macroscopic features
- Organ becomes enlarged and rounded.
- Weight of organ increases.
- Bulging on cut surfaces.
- Amount of fluid increases in organ.

Microscopic features
- Swelling of cells, edges become rounded.
- Increased size of cells.
- Cytoplasm of the cells becomes hazy/cloudy due to increased granularity.
- Can be seen in liver, kidney and muscles.

HYDROPIC DEGENERATION
Cells swell due to intake of clear fluid. Such cells may burst due to increased amount of fluid and form vesicle. Hydropic degeneration can be seen in epithelium of skin and/or mucous membranes of body (Fig. 6.3 & 6.4)

Etiology
- Mechanical injury
- Burns
- Chemical injury
- Infections like foot and mouth disease virus, pox virus etc.

Macroscopic features
- Vesicle formation
- Accumulation of fluid under superficial layer of skin/mucus membrane.
- Heals rapidly within 2-4 days
- No scar formation
- Pyogenic organisms may convert it into pustule.

Microscopic features
- Cell size increases due to accumulation of clear fluid in cytoplasm.
- Droplets in cytoplasm as vacuoles.
- Cell bursts and epithelium protrudes leading to blister.
- Mostly affects prickle cell layer (Stratum spinosum) of skin.

MUCINOUS DEGENERATION
Excessive accumulation of mucin in degenerating epithelial cells. Mucin is a glassy, viscid, stringy and slimy glycoprotein produced by columnar epithelial cells on mucus membranes. Such cells burst to release the mucin in lumen of organ and are called as goblet cells. When mucin is mixed with water, it is known as mucus (Fig.6.5 & 6.6).

Etiology
- Any irritant to mucus membrane like chemicals and infection.
- Bacteria e.g. E. coli
- Virus e.g. Rotavirus
- Parasite e.g. Ascaris

Macroscopic features
- Over production of mucus in intestines which covers intestinal contents/ stool.
- Over production of mucus in genital tract during oestrus and is characterized by mucus discharge from vulva.
- Nasal discharge during respiratory mucosa involvement.
- Mucus is mucin mixed with water and slimy and stringy in nature.

Microscopic features
- Increased number of goblet cells.
- Goblet cells are elliptical columnar cells containing mucus.
Fig. 6.1. Diagram showing Cloudy swelling in liver

Fig. 6.2. Photomicrograph of liver showing cloudy swelling

Fig. 6.3. Diagram showing hydropic degeneration and vesicle in skin

Fig. 6.4. Photomicrograph of hydropic degeneration in skin

Fig. 6.5. Photograph of intestine showing mucous degeneration

Fig. 6.6. Photomicrograph of intestine showing mucous degeneration

Fig. 6.7. Photomicrograph of spleen showing amyloid infiltration

Fig. 6.8. Photomicrograph showing hyaline in muscles
- Mucin in lumen stains basophilic through H & E staining.
- Seen on mucous surfaces only.

**MUCOID DEGENERATION**
Mucoid degeneration is mucin like glycoprotein deposits in connective tissue.

**Etiology**
- In embryonic tissue *e.g.* umblical cord.
- In connective tissue tumors *e.g.* Myxosarcoma.
- Myxedema due to thyroid deficiency.
- In cachexia due to starvation, parasitism or chronic wasting diseases.

**Macroscopic features**
- Shrunken tissue giving translucent jelly like appearance.
- A watery, slimy and stringy material on cut surface.

**Microscopic features**
- Mucoid degeneration tissue stains blue
- Nuclei are hyperchromatic.
- Fibrous tissue as pale blue.
- Usually accompanied by fat necrosis.

**PSEUDOMUCIN**
Pseudomucin is secretion of ovaries and is observed in cystadenomas. However, it is not a disturbance of cell metabolism.

**Etiology**
- Cystadenoma, cystadenocarcinoma
- Parovarian cysts.

**Macroscopic features**
- Transparent, slimy similar to mucin.
- It is not precipitated by acetic acid while mucin is precipitated.

**Microscopic features**
- Homogenous like plasma stains pink with H&E stain
- Extracellular

**AMYLOID INFILTERATION**
Deposition of amyloid between capillary endothelium and adjacent cells. Amyloid is a starch like substance which stains brown/blue/black with iodine and chemically is protein polysaccharide (Fig. 6.7).

**Etiology**
- Not exactly known.
- It is thought to be due to antigen-antibody reaction/deposition of immune complexes in between capillary endothelium and adjacent cells.

**Macroscopic features**
- Organ size increases with rounded edges, pits on pressure, cyanotic/yellow in colour and fragile.
- *Sago spleen* due to deposition of gray, waxy sago like material.

**Microscopic features**
- Amyloid stains pink on H&E stain.
- It is a permanent effect in body and remains in whole life without causing much adverse effects.

**HYALINE DEGENERATION**
Glossy substance (glass like) solid, dense, smoothly homogenous deposits in tissues. Tissue becomes inelastic. It is a permanent change. Hyaline is very difficult to distinguish macroscopically (Fig. 6.8).

**Etiology**
- Disturbance in protein metabolism
- No specific cause

**Macroscopic and Microscopic features**
*Connective tissue hyaline*
- In old scars, due to lack of nutrients; homogenous, strong acidophilic and pink in colour. There are no nuclei and no fibrils.

*Epithelial Hyaline*
- Starch like bodies in prostate, lungs, kidneys.
- Microscopically characterized by round, homogeneous, pink, within an alveolus of lung.
- Homogenous, pink in kidney tubules/glomeruli (Fig. 6.9).

**Keratohyaline**
- Occurs due to slow death of stratified squamous epithelial cells and because of lack of nutrients. Keratinized epithelium is firm, hard and colourless. Microscopically, it is seen in epithelial pearls e.g. horn cancer, warts (Fig. 6.11).

**FATTY CHANGES**
Intracellular accumulation of fat in liver, kidneys and heart. It is a reversible change.

**Etiology**
- Increased release of fatty acids.
- Decreased oxidation of fatty acids.
- Lipotrope deficiency.
- In ketosis, diabetes, pregnancy toxaemia.

**Macroscopic features**
- Enlargement of organ.
- Cut surfaces are bulging and greasy.
- Organ colour becomes light.

**Microscopic features**
- Intracellular deposition of fat droplets.
- In cytoplasm clear round/oval spaces with eccentrically placed nucleus.
- Stains yellow orange with sudan III.
GLYCOGEN INFILTRATION
(GLYCOGEN STORAGE DISEASE)
Glycogen accumulates when increased amount of glycogen enters in the cells of kidneys, muscles and liver (Fig. 6.12).

Etiology
- Diabetes mellitus.
- Impaired carbohydrate metabolism due to drugs e.g. corticosteroid therapy.

Macrosopic features
- Affect organ becomes enlarged.

Microscopic features
- Intracellular deposits of glycogen in cells of kidneys, liver and muscles.
- Small clear vacuoles seen in distal portion of proximal convoluted tubules, hepatocytes etc.
- It can be stained as bright red by Best’s, Carmine and PAS and reddish brown by iodine.

MODEL QUESTIONS

Q. 1. Fill in the blanks with suitable word(s).
1. Cells swell due to accumulation of clear fluid in ……………….which occurs in ……………. layers of epithelial cells or mucous membrane in case of ………………. disease.
2. Pyogenic bacteria invades the vesicle and may convert it into ………..…..
3. Cloudy swelling is a ………………. reaction against ………………. injury/ irritant and it is the ……………….reaction of body.
4. Mucoid degeneration occurs due to …………….. deficiency and in …………….. due to ……………..and ……………..in disease.
5. Pseudomucin appears in ……………. and ……………. and characterized by appearance of ……………. and …………….material like mucin.
6. Amyloid is …………….like substance which stains ……………..with iodine and chemically it is …………….. .
7. Connective tissue hyaline is seen in ……………. due to lack of ……………..and characterized by …………….. and pink in colour.
8. Keratohyaline is ……………. due to lack of nutrients and occurs in ……………..cancer.

Q. 2. Write True or False against each statement. Correct the false statements.
1. ………..Vesicle formation occurs as a result of breaking of cells due to cloudy swelling.
2. ………..Amyloid is caused by antigen-antibody complexes.
3. ………..Mucinous degeneration occurs in connective tissues with accumulation of slimy and stringy material.
4. ………..Epithelial hyaline is characterized by the presence of epithelial pearls.
5. ………..Diabetes mellitus may lead to glycogen storage disease.
6. ………..Hydropic degeneration mostly occurs in prickle cell layer of skin or mucous membrane.
7. ………..Cachexia due to starvation may lead to mucoid degeneration.
8. ………..Cloudy swelling is characterized by hazy and cloudy cells due to swelling of mitochondria.
9. ………..Mucin is mucus mixed with water and stringy in nature.
10. ………..Glycogen is stained as redish brown by PAS.
Q. 3. Write short notes on.
1. Fatty changes
2. Keratohyaline
3. Glycogen storage disease
4. Mucus
5. Cloudy swelling

Q. 4. Define the followings.
1. Pseudomucin
2. Mucin
3. Hyaline
4. Amyloid
5. Vesicle
6. Pustule
7. Goblet cells
8. Sago spleen
9. Epithelial pearl
10. Sodium pump

Q. 5. Differentiate the followings.
1. Mucinous and mucoid degeneration
2. Vesicle and Pustules
3. Cloudy swelling and hydropic degeneration
4. Hyaline and amyloid infiltration
5. Fatty changes and glycogen infiltration.

Q. 6. Select suitable word(s) from the four options to correct the following statements.
1. Hydropic degeneration leads to …………… formation in skin.
   (a) Vesicle    (b) Pustule    (c) Scab    (d) Papule
2. Cloudy swelling is characterized by hazy cytoplasm due to swollen ………
   (a) Endoplasmic reticulum (b) Golgi bodies    (c) Mitochondria    (d) Nucleus
3. The mucous containing cells in mucous membranes are known as ………
   (a) Epithelial cells    (b) Pearl cells    (c) Columnar cells    (d) Goblet cells
4. Mucin stains ………….. by H&E stain.
   (a) Blue    (b) Pink    (c) Yellow    (d) Black
5. Sago spleen is observed in ………
   (a) Amyloid    (b) Mucin    (c) Hyaline    (d) Pseudomucin
6. Epithelial pearl is an example of ………
   (a) Amyloid    (b) Mucin    (c) Hyaline    (d) Cell Swelling
7. Ketosis in cow may cause …………
   (a) Hyaline degeneration    (b) Fatty change    (c) Amyloid    (d) Cell swelling
8. Mucous degeneration in intestine is caused by ……………
   (a) Rotavirus    (b) E. Coli    (c) Ascaris    (d) All of the above
9. Corticosteroid therapy may lead to …………
   (a) Fatty changes    (b) Hyaline    (c) Glycogen    (d) Cell swelling
10. Amyloid occurs in body as a result of …………
    (a) Immune complexes    (b) Antigen    (c) Antibody    (d) Starch