DISTURBANCES IN CALCIFICATION AND PIGMENT METABOLISM

- Calcification
  - Dystrophic
  - Metastatic
- Pigmentation
  - Endogenous pigments
  - Exogenous pigments
- Crystals
  - Urates and uric acids (Gout)
- Model Questions
CALCIFICATION
Calcification is the deposition of calcium phosphates and calcium carbonates in soft tissues other than bones and teeth. It may be classified as dystrophic and metastatic calcification.

DYSTROPHIC CALCIFICATION
Dystrophic calcification is characterized by the deposits of calcium salts in necrosed tissue of any organ (Fig 8.1).

Etiology/Occurrence
- Necrosis
- Parasitic infections
- Tuberculous lesions

Macroscopic features
- Organ becomes hard, nodular.
- Gray/white deposits in necrosed tissue looking like honey comb.
- Gritty sound on cutting.

Microscopic features
- Irregular deposits of calcium salts in necrosed tissue.
- Calcium takes black/purplish colour on H & E staining.

METASTATIC CALCIFICATION
Metastatic calcification is characterized by deposition of calcium salts in soft tissue as a result of hypercalcemia (Fig. 8.2).

Etiology/Occurrence
- Hyperparathyroidism
- Renal failure
- Excess of vitamin-D
- Increased calcium intake.

Macroscopic features
- Organ becomes hard
- Wall of arteries becomes hard due to calcium deposits.

Microscopic features
- Deposition of calcium in soft organs like myocardium, arteries, muscles, etc.
- Purplish/black colour calcium surrounded by comparatively normal tissue.

MELANOSIS
Melanosis is the deposition of melanin, a brown/black pigment in various tissues/ organs specially in lung, blood vessels and brain (Fig. 8.3 to 8.5).

Etiology/Occurrence
- Hyperadrenalism
- Melanosarcoma
- Melanoma

Macroscopic Features
- Organ/tissue involved becomes black in colour.
- Discolouration may be focal or diffused.

Microscopic features
- Brown/black colour pigment is seen in cells.
- The size, shape and amount of pigment vary.

HEMOSIDEROSIS
Hemosiderosis is characterized by deposition of hemosiderin pigment in spleen and other organs. Hemosiderin is a blood pigment with a shiny golden yellow colour and is usually found within the macrophages (Fig. 8.6).

Etiology/Occurrence
- Extensive lysis of erythrocytes
- Haemorrhage
- Hemolytic anemia

Macroscopic features
- Colour of organ becomes brownish
- Brown induration of lungs

Microscopic features
- Presence of golden yellow/golden brown pigment in red pulp of spleen, lungs, liver and kidneys.
Fig. 8.1 Photomicrograph of lung showing dystrophic calcification in tuberculous granuloma

Fig. 8.2 Photomicrograph of arteries showing metastatic calcification

Fig. 8.3. Photograph showing melanosis

Fig. 8.4 Photomicrograph of skin showing melanosis

Fig. 8.5. Photomicrograph of skin showing melanosis.

Fig. 8.6 Photomicrograph of spleen showing hemosiderosis

Fig. 8.7 Photomicrograph of lung showing pneumoconiosis

Fig. 8.8 Photograph of foot pad of a bird showing gout
In most of the cases, the pigment is found intracellularly in macrophages.

**BILE PIGMENTS**

Bile pigments are derived from the breakdown of erythrocytes such as bilirubin and biliverdin. The icterus is hyperbilirubinemia as a result of either excessive lysis of erythrocytes or due to damage in liver or obstruction in the bile duct. The haemolysis resulted into iron, globin and porphyrin; the latter being converted into biliverdin. Biliverdin is reduced to produce bilirubin, an orange yellow pigment and bound to albumin and transported by RE cells to liver. In hepatic cells, it is separated from albumin and conjugated with glucuronic acid and excreted in bile as bilirubin diglucuronide. In intestine, it is further reduced by bacteria to urobilinogen, which is reabsorbed into circulation and carried to liver for reexcretion in bile while small amount enters in circulation and excreted through urine. The unabsorbed urobilinogen is oxidized in lower intestine to form urobilin and stercobilin, which gives normal pigment to faeces.

![Fig. 8.9. Photomicrograph of kidney showing urates (gout)](image1)

![Fig. 8.10. Photograph of a bird showing deposition of urates and uric acid in ureter (gout)](image2)
ICTERUS
Icterus is increased amount of bile pigments in blood circulation and is often called as hyperbilirubinemia or jaundice. It is of three types hemolytic, toxic and obstructive jaundice.

HEMOLYTIC JAUNDICE
Hemolytic jaundice occurs as a result of excessive hemolysis in circulating blood. It is also known as prehepatic jaundice.

Etiology/ Occurrence
- Piroplasmosis (Babesia bigemina)
- Anaplasmosis (Anaplasma marginale)
- Leptospirosis (Leptospira ictehaemmorrhagae)
- Equine infectious anemia virus
- Anthrax (Bacillus anthracis)
- Clostridium hemolyticum
- β-haemolytic streptococci

TOXIC JAUNDICE
Toxic jaundice occurs as a result of damage in liver leading to increased amount of unconjugated and conjugated bilirubin in blood. It is also known as hepatic jaundice.

Etiology
- Toxin/Poisons
- Copper poisoning
- Leptospirosis

OBSTRUCTIVE JAUNDICE
Obstructive jaundice occurs as a result of obstruction in bile duct causing hindrance in normal flow of bile. It is also known as post hepatic jaundice.

Etiology
- Blocking of bile canaliculi by swollen hepatocytes
- Obstruction in bile duct (Liver flukes, tapeworms and ascaris)
- Biliary cirrhosis, Cholangitis and Cholelithiasis
- Pressure on bile duct due to abscess, neoplasm.
- Inflammation and swelling at duct opening in duodenum.

Macroscopic features
- Mucous membrane yellow in colour.
- Omentum, mesentry, fat become yellow.
- Increased yellow colour in urine.
- Conjunctiva becomes yellow.

Microscopic features
- Brownish pigment in tubules of kidney
- Bile pigments in spleen
- Hemolysis, erythrophagocytosis
- Hepatitis

Diagnosis
- Van-den- Bergh reaction
- Direct reaction detects bilirubin diglucuronide (Obstructive jaundice)
- Indirect reaction detects hemobilirubin (Hemolytic jaundice)
- Both reaction (Toxic jaundice)

PNEUMOCONIASIS
Pneumoconiosis is the deposition of dust/carbon particles in lungs through air inhalation. It is also known as anthracosis (carbon), silicosis (silica) or asbestoses (asbestous) (Fig 8.7).

Etiology/ Occurrence
- Dusty air containing carbon/silica/asbestous
- Near factory/coal mines.

Macroscopic features
- Hard nodules in lungs
- Nodules my have black /brown /gray colour
- Nodules may produce cracking sounds on cut

Microscopic features
- Presence of carbon/other exogenous pigment in intercellular spaces or in cytoplasm of alveolar cells and macrophages.
- Formation of granuloma around the foreign particles including the infiltration of
macrophages, lymphocytes, giant cells and fibrous tissue proliferation.

CRYSALS
Deposition of different kinds of crystals in tissues like uric acid, sulfonamides and oxalates etc. The uric acid and urates when deposits in tissues it is known as gout.

GOUT
Gout is a disease condition in which urates and uric acid deposited in tissues characterized by intense pain and acute inflammation (Fig. 8.8 to 8.10).

Etiology/occurrence
• Common in poultry due to deficiency of uricase enzyme.
• Deficiency of vitamin-A
• Absence or inadequate amount of uricase

Macrosopic features
• White chalky mass of urates and uric acid.
• Deposition of urates/uric acid on pericardium, kidneys etc.
• Dialation of ureter due to excessive accumulation of urates.

Microscopic features
• Presence of sharp crystals in tissue
• Crystals are surrounded by inflammatory cells including macrophages, giant cells and lymphocytes

MODEL QUESTIONS

Q. 1. Fill in the blanks with suitable word(s).
1. Metastatic calcification is characterized by deposition of calcium in soft tissues as a result of ................. which is caused by .................. .................... and .................
2. Hemosiderosis is the deposition of pigment in spleen which is seen as ................. colour and usually found in the ....................
3. Melanin is a ..........colour pigment usually gives colour to ................. ............and .................
4. Bilirubin is a ................. pigment occurs in body due to ................. ............ and ................., which is characterized by ................. colour of .................
5. In liver bilirubin is conjugated with......... to give rise to.............. which is excreted in bile and reduced in intestine to......... unabsorbed portion is converted into......... and...........

Q. 2. Write true or false against each statement and correct the false statements.
1. ......Bilirubin is produced as a result of reduction of biliverdin.
2. ......Hyperadrenalism may lead to melanosis.
3. ......Stercobilin gives colour to urine
4. ......Hemolytic anemia may give rise to hemosiderosis.
5. ......The swollen hepatocytes may cause the appearance of both conjugated and unconjugated bilirubin in blood.
6. ......Necrosed tissue is after some time calicified due to hypercalcemia
7. ......Excessive hemolysis may cause jaundice.
8. ......Urobilin gives colour to urine and faeces
9. ......Hemosiderin is green or red colour pigment.
10. ......Anaplasmosis may cause post hepatic jaundice.
Q. 3. Write short notes on.
1. Dystrophic calcification
2. Hemosiderosis
3. Melanosis
4. Hemolytic jaundice
5. Gout
6. Toxic icterus
7. Van den Bergh reaction
8. Metastatic calcification
9. Pneumoconiosis
10. Obstructive jaundice

Q. 4. Define the followings.
1. Silicosis
2. Urobilinogen
3. Gout
4. Urobilin
5. Asbestoses
6. Anthracosis
7. Uricase
8. Stercobilin
9. Hemosiderin
10. Pneumoconiosis

Q. 5. Select appropriate word(s) from four options given against each statement.
1. Dystrophic calcification occurs in animals due to ...............
   (a) Tuberculosis   (b) Parasitic infection   (c) Necrosis   (d) All of the above
2. Melanosis is the brown/black discolouration of tissue/organ as a result of excessive accumulation of melanin due to ...............
   (a) Hyperadrenalism   (b) Hyperthyroidism   (c) Hyperparathyroidism   (d) Hypermelanemia
3. Hemosiderin is ............colour pigment.
   (a) Green   (b) Red   (c) Golden Yellow   (d) Blue
4. Urobilinogen is the ............form of bilirubin.
   (a) Unconjugated   (b) Conjugated and reduced   (c) Conjugated   (d) Conjugated and oxidised
5. Hemolysis may give rise to ............
   (a) Prehepatic icterus   (b) Posthepatic icterus   (c) Toxic icterus   (d) None of the above
6. Obstructive jaundice occurs as a result of
   (a) Hemolysis   (b) Liver necrosis   (c) Cholangitis   (d) Prioplasmosis
7. Indirect Van den Bergh reaction is an indication of ............
   (a) Obstructive icterus   (b) Hemolytic icterus   (c) Hepatic jaundice   (d) None of the above
8. Deposition of carbon particles in lungs is known as ............
   (a) Silicosis   (b) Asbestoses   (c) Pneumoconiosis   (d) Anthracosis
9. Gout is the deposition of ............ in tissues.
   (a) Uric acid crystals   (b) Oxalate crystals   (c) Hemosiderin   (d) Urobilin
10. The absence of ............ in poultry is the main cause of gout.
    (a) Trypsin   (b) Lymphnodes   (c) Amylase   (d) Uricase