

MORPHOLOGICAL CHANGES IN MALARIA

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Malaria remains a global health problem. Several organs of the body are affected by the Plasmodium species which parasitized erythrocytes. The small blood vessels of all the major organs of the body are usually filled with parasitized red cells and this represents the major morphological changes seen in malaria. Other common findings include hyperaemia and congestion and deposition of haemozoin at various sites in these organs and scattered small haemorrhages in various organs of the body. More organ-specific findings include fatty infiltration of the liver, hyaline membrane formation in the lungs, fatty degeneration of myofibrils and brown atrophy in the heart and "Durck" granuloma in the brain. This is a review of the various morphological changes seen in malaria.

Key words: Morphological changes, Malaria

INTRODUCTION

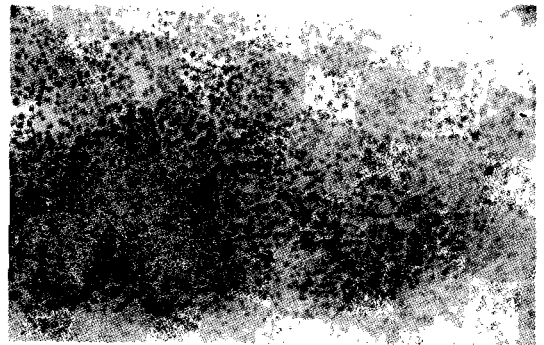
Many organs show morphological changes in both the acute and chronic stages of malaria. Parasitization is greatest in descending order in the following organs: brain, heart, liver, lung, kidney and blood (1-3). Secondary changes can occur in all the other major organs, depending on the type and severity of the infection. We review the morphological changes in malaria in all the major organs of the body.

Spleen

The spleen is the first organ to show morphological changes (4). These changes can be seen as early as two weeks after infection. In the acute stage, there is splenomegaly. The cut surface shows congestion and is slaty greyish with the Malpighian corpuscles prominent (3). Microscopy demonstrates the presence of parasitized red cells in the blood vessels, Billroth cords and sinusoids (5).

The parasitized and unparasitized red cells and haemozoin are seen in the pulp

histiocytes and sinusoidal lining cells (5) (Fig 1).



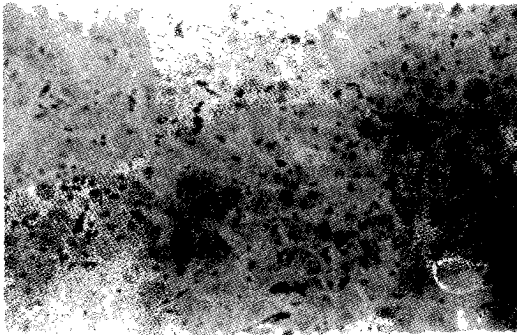
Haemozoin is an iron-porphyrin complex that is phagocytosed and processed by the macrophages. The pigment is seen as crystalline clump of dark-green material that polarizes under polarising light (5). Degeneration of the endothelial cells of splenic vessels may be seen resulting in thrombosis, haemorrhage and infarction (3).

Liver

The histopathological changes due to malarial involvement of liver are specific (5-7). During the acute stage of an attack, the Kupffer cells demonstrate hypertrophy and hyperplasia (5, 6). The liver is congested

with a grey or black pigmentation as a result of accumulation of haemozoin (5). Microscopically, in acute malaria, there is a pronounced hyperaemia with dilatation of all capillaries (7). Parasitized red cells may be attached to endothelial of the vessel and Kupffer cells may contain parasitized red cells (7).

Following survival of an acute attack, haemozoin gradually migrates from the parenchyma to portal areas (5, 7) (Fig 2).



Fatty infiltration may be seen throughout the liver, but particularly around the centrilobular vein (3, 8). Focal hepatocyte necrosis may also be seen and these two changes are usually attributable to poor nutritional status (8). Malaria is not considered to be precirrhotic (7).

Kidneys

In severe malaria, there is gross congestion of the vessels with parasitized red cells, especially in the capillaries of the glomerular tuft (3). Scattered small haemorrhages may be seen in the cortex and medulla (9). The histological changes are those of acute tubular necrosis due to reduced cortical perfusion (10).

Pigments are widely seen in blood vessels and interstitial tissue and occasionally in the epithelial cells of the tubules and within phagocytes in the capsular spaces (10). Hyaline, epithelial and

granular casts may be present in the tubules (10). *Plasmodium malariae* causes a nephropathy of immune complex origin with microscopical patterns ranging from minimal change to membranous glomerulonephritis (9).

Lungs

The small blood vessels of the lung are packed with parasitized red cells and small haemorrhages may be present (11). There may also be hyaline membrane formation, thickened alveolar septa and areas of alveolar haemorrhages (11). The alveoli are congested with pigment-laden macrophages, plasma cells, neutrophils and parasitized red cells.

Cardiovascular system

The vessels are congested with parasitized red cells, pigment-laden macrophages, lymphocytes and plasma cells (3). There may be small subendocardial haemorrhages (3) and fatty degeneration of the myofibrils and brown atrophy may also be seen.

Adrenal glands

The changes in the adrenal glands are variable (3). Degenerative and necrotic changes are seen in the inner zone of the cortex with loss of lipid. The more usual findings are gross congestion and haemorrhage (3).

Bone marrow

The bone marrow is greyish red, soft and hyperaemic and there is hyperplasia^a in the long bones (12). In the acute stages, the vessels are full of parasitized red cells and haemozoin is present in the reticulo-endothelial system and monocytes. There is marked normoblastic hyperplasia, even in the absence of peripheral reticulocytosis and there is myelocytic proliferation (12).

Gastrointestinal system

There is congestion with capillary stasis, necrosis, mucosal ulceration and haemorrhage (3).

Central nervous system

Although changes have been reported in the spinal cord and peripheral nerves, the most marked changes are seen in the brain itself (13). The central neuropathological feature of cerebral malaria is the preferential sequestration of parasitized red cells in the cerebral microvasculature (14). The meninges are grossly congested with the smaller vessels packed with parasitized red cells. The brain may show gross congestion only but it is usually leaden in colour (13). Gross congestion of the vessels is a constant finding and in the majority of instances, numerous petechial haemorrhages are evident in the white mater of the cerebrum, brain stem and cerebellum (14). Haemorrhages are not usual in the grey mater.

Histologically, the capillaries and arterioles are packed with parasitized red cells and ring haemorrhages are prominent (3). Ring haemorrhages consist of a central vessel, which is usually an arteriole, containing an agglutinated mass of parasitized red cells surrounded by brain tissue and then by a ring of extravasated red cells.

Malarial or "Durck" granuloma may be seen in older haemorrhages. This consists of necrosis of the midzonal brain tissue and a peripheral reaction of small glial cells. Immunohistochemical and electron microscopy would demonstrate widespread cerebral endothelial cell

activation, in addition to endothelial cell damage and necrosis (13).

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