Chapter 3

The Normal Fundus and Its Variants

The normal fundus

Macula

Anatomically the macula is the area centred within the temporal arcades measuring about 5.5 mm (3.5 disc diameter, DD).

Fovea

The fovea is a concavity in the centre of the macula measuring about 1.5 mm or 1.0 DD. It is the most sensitive part of the retina, serving the function of high spatial resolution and colour vision. On fundoscopy, due to its concavity, a fovea maintaining its normal architecture shows a bright reflex known as the foveal reflex.

Foveola

A central 0.35 mm of the fovea is known as the foveal avascular zone (FAZ) of the retina as it is free of retinal capillaries. This area consists purely of cone photoreceptors and no overlying inner layers of the retina.
A normal fundus.
Retinal arteries
The walls of the retinal blood vessels are transparent and therefore we see the column of blood flowing in them. On fundoscopy, the arteries appear lighter and narrower (arteriovenous ratio of 2:3) compared to the retinal veins. The central retinal artery emerges at the optic disc and divides into four branches (superotemporal, inferotemporal, superonasal and inferonasal). In the retina they divide dichotomously until third-order branches finally form a two-tier perivenular capillary network. The superior branches respect the horizontal raphe and normally do not communicate with the inferior branches. The retinal capillary wall is lined by endothelial cells and pericytes which form a tight inner retinal barrier. The retinal blood vessels are autoregulated like those of the brain.

Retinal veins
The perivenular capillaries ultimately form the four main branches (superotemporal, inferotemporal, superonasal and inferonasal) before forming the central retinal vein at the optic disc. The vessels cross over one another in the retina.

The optic disc
Measuring about 1.5 mm, the optic disc lies about 3 mm nasal to the fovea. The edge of the optic disc may be slightly elevated. The immediate peripapillary area may show hyperpigmentation or a scalloped pale area representing the sclera, seen through the transparent retina. The only neuroretinal elements at the optic disc are the axons of the ganglion cells which make up the neuroretinal rim. The central part, the optic cup, occupying around 30% of the entire optic disc area, is paler and appears depressed on binocular stereo fundoscopy. The central retinal vessels enter and leave in this depression. Spontaneous venous pulsations are often seen at the optic disc; however, they may be absent in around 20% of normal individuals. The optic disc also has small capillaries. Physiologically the optic disc represents the blind spot.
Normal fundus variants

Tigroid

In a tigroid fundus there are lesser amounts of pigment in the retinal pigment epithelium, allowing streaks of underlying normal choroidal pigmentation to become visible and give the characteristic appearance.

Tigroid fundus: larger choroidal vessels with interspersed choroidal pigment showing through.
Myelinated nerve fibres

Myelinated nerve fibres are relatively common and may follow several patterns:

- Isolated peripheral patch of myelination.
- Pericapillary myelination may be mistaken for papilloedema on examination.
- The myelinated nerve fibres follow the pattern of normal fibres and extend as regular, feather-like patches, which may or may not obscure the retinal blood vessel. Although myelination usually remains stationary, it may very well disappear in optic atrophy following either optic neuritis or ischaemia. It may be associated with neurofibromatosis-1.
Myelinated nerve fibres. Note the pale appearance adjacent to the optic disc corresponding to arrangement or pattern of retinal nerve fibres.
Albino fundus

Melanocytes normally synthesise melanin in the retinal pigment epithelium. Absence of melanin due to any defect in its synthesis allows the choroidal vasculature to be seen under the retinal vessels.

Ocular albinism is a rare X-linked disorder, affecting the eyes only.

Oculocutaneous albinism is an autosomal recessive condition, characterised by hypopigmentation of skin, hair, fundus and irides. It is often associated with a decrease in visual acuity, photophobia and nystagmus.

Such patients may be classified as tyrosinase positive or negative, with the degree of pigmentation usually being greater in tyrosinase-positive patients.

Albino fundus: note the lighter fundal reflex with large choroidal vessels showing through. Absence of normal macular pigmentation and loss of foveal reflex represents macular hypoplasia.
Artefacts in the normal fundus

Note eye lash artefact inferior to the optic disc.
Blurred fundus image due to media opacity caused by cataract.