CORNEAL VASCULARIZATION

Essay

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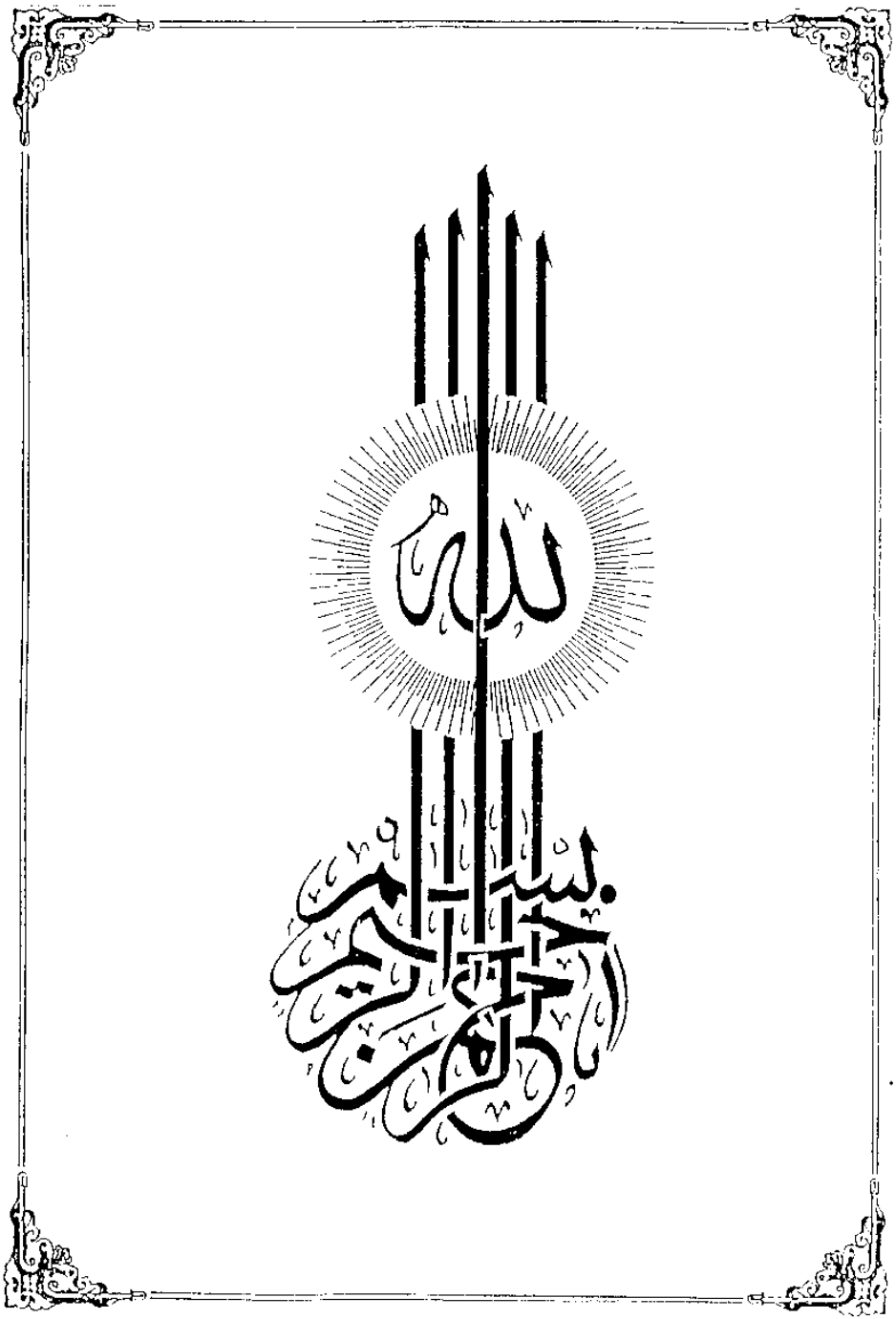

C O N T E N T S

INTRODUCTION AND AIM OF THE WORK

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Corneal diseases are very important, the special importance of the cornea is that sometimes acquire permanent opacities, these are frequently associated with corneal vascularization which seriously lower the visual acuity.

Corneal vascularization results from many corneal diseases, an exact knowledge of their position, whether superficial or deep, and of their distribution, whether localised or generalised, is of diagnostic importance. As the cornea and its transparency have a special importance as regard to the visual acuity, so this essay is aimed to review the more recent hypothesis in corneal vascularization to know the cause, mechanism and treatment. Again the essay is concerned with already present corneal vessels, and how to solve this ptoblem by surgical, medical and radiological methods.

ANATOMY OF THE CORNEA

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Gross anatomy:

The cornea is the transparent, anterior, avascular tissue of the outer coat of the eye. When viewed anteriorly in the living eye the human cornea is somewhat elliptical, being about 12 mm in the horizontal meridian and 11 mm in the vertical meridian.

The cornea is thinner centrally, averging about 0.58 mm, whereas the periphery measures approximately 1 mm in the thickness. The total refractive power of the cornea is about 43 diopters (D), or 70% of the refractive power of the eye. The central one third of the cornea is almost spherical and is the optical zone. The cornea flattens peripherally, contributing to the increased thickness of the edge of corneal area (Grayson, 1983).

The radius of curvature of the anterior corneal surface is about 7.8 mm. This is somewhat shorter than the 11.5 mm radius of curvature of the eye ball as a whole, resulting in a small groove where the shorter radius of curvature of the cornea meets that of a larger curvature of the sclera. This groove or sulcus is known as the limbus. This is a definite anatomic landmark, an important structure to recognize for purposes of planning

surgical entry into the anterior segment of the eye. The radius of curvature of the posterior corneal surface is shorter about 6.5 mm (Raymond , 1979).

Microscopic anatomy:

Behind the precorneal tear film there are the following five layers:

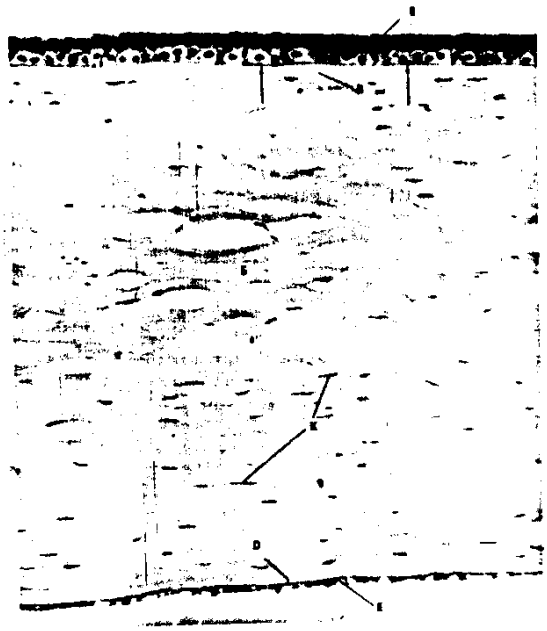
1- Epithelium:

It consists of a five-cell layer with three types of cells: columnar basal, polygonal wing, and flat superficial cells (Grayson, 1983).

The deeply situated basal cells, stand in palisade-like manner in perfect alignment, on a basement membrane. These basal cells are columnar with rounded heads and flat bases, which often present processes which spread out on the basement membrane (Wolff, 1976).

New cells are constantly being used and migrate superficially to become wing cells (Grayson, 1983).

The wing cells are polyhedral cells whose rounded heads are directed anteriorly and whose concave bases fit over the heads of the basal cells and send processes, the wings, between them. The next two or three layers are also polygonal, and the most superficial are flattened



Normal cornea. (Rabb, 1978).

but do not lose their nuclei, nor do they normally show keratinisation. The flattened nuclei of the surface cells project backwards leaving the surface perfectly smooth, which makes it the most brilliant in the body (Wolff , 1976).

The epithelial cells of the cornea are interdigitated and firmly attached to each other by many desmosomes. The tight attachment between the cells, together with the fact that the membranes of the basal cells are flat, suggests that the epithelium restricts passage of fluid through this layer.

On scanning electronmicroscopy, flat and mostly hexagonal epithelial cells are seen attached to each other by straight cell boundaries.

Grossly the surface of the epithelium looks like a very shiny mirror; however, on scanning electronmicroscopic examination with a high power the surface cell membrane appears finely reticulated. The reticulated surface usually gives a vermiform appearance. When drying of the cornea occurs, this vermiform like surface structure is absent (Grayson, 1983).

2- Bowman's membrane:

It is a thin homogenous sheet about 8-14 um thick

between the basement membrane and the substantia propria. It is separated from the epithelium by a sharply defined border, and under pathological conditions as well as after death the epithelium separates readily from the Bowman's membrane.

The anterior surface of Bowman's membrane is absolutely parallel with the surface of the cornea. Hence the difficulty often of seeing abrasions which have removed the whole thickness of the epithelium.

Posteriorly, the line of demarkation from the stroma is ill-defined. In fact, it may be regarded as a modified portion of the stroma. Peripherally it ends abruptly in a rounded border.

Bowman's membrane is not truely elastic, nor does it regenerate when it has been destroyed. It shows a good deal of resistance to injury or infection.

By electrone microscopy, an acellular mass of collagen fibrils are disposed irregularly (Wolff, 1976).

The collagen fibrils are randomly distributed but are uniform in diameter, these fibrils increase and gradually transform into the regular stroma (Grayson, 1983).

3- Stroma:

The stroma, which constitutes about 90% of the cornea, consists of collagen fibres, stromal cells and ground substance.

It is well known that the bundles of collagen fibers are arranged into lamellae parallel to the tear surface. Interlacing lamellae cross each other at right angles in a highly regular fashion, and layers of lamellae run parallel to each other and to the surface of the cornea.

Each lamella runs the full length of the cornea and is made up of a multitude of collagen fibres. The layered arrangement of the fibres facilitates lamellar disection of the cornea.

The ground substance surrounding the collagen fibres is rich in mucopolysaccharide. In swollen corneas the volume of the ground substance increases, but the individual collagen fibres does not change.

The keratocyte is a large cell with a number of large processes that extend out from beyond the cell body in a satellite fashion. The cells are seen between packed collagen lamellae and the tips of the processes touch neighbouring cells.

In addition to the keratocyte, wandering cells may be seen when they invade the corneal stroma. Small numbers of invading cells, including polymorphonuclear leukocytes, plasma cells and histiocytes are seen in the normal stroma, located between the lamellae of the collagen fibres (Grayson, 1983).

Electron microscopy of stroma confirms the alternating direction of the fibres (Wolff, 1976).

4- Descement's membrane:

It is a strong, homogenous and very resistant membrane, about 10-12 um thick (Wolff, 1976).

It is easily detached from the stroma and after injury, it regenerates readily. It can proliferate over the angle of the anterior chamber and onto the iris and can also form the endothelial warts and hyaline ridges seen in a number of pathological problems. Generally, it thickens with age. The Schwalbe's ring, an accumulation of circular collagen fibrils, marks the termination of Descement's membrane.

By electron microscopy, Descement's membrane is divided into an anterior zone which is known as the banded zone and a posterior zone which consists of more newly formed basal lamina substance.

The endothelial cells, when stimulated by inflammation, trauma or genetic substance, produces excess basal lamina, causing thickening of Descement's membrane and Descement's wart formation (Grayson, 1983).

5- Endothelium:

It is the most posterior layer of the cornea, and consists of a single layer of flattened epithelial-like cells, continuous round the angle of the anterior chamber with any remanants of the fetal endothelium which may persist on the front of the iris.

By electron microscopy, there is no basement membrane. Descement's membrane is sometimes considered to be the basement membrane.

Abundant cellular organelles indicate a high degree of metabolic activity (Wolff, 1976).

Corneal vessels:

The cornea is avascular. It is generally stated, however, that small loops derived from the anterior ciliary vessels invade the periphery for about 1 mm. But these vessels are not in the cornea. They are in the subconjunctival connective tissue which overlaps it. The nourishment is obtained by lymphatic permeation through the spaces between the lamellae (Wolff, 1976).