The turnover of cells of the Corneal Epithelium

Graeme Wilson O.D., Ph.D.

The corneal epithelium is an extraordinary structure. It must survive in an environment almost as hostile as that of the skin. At the same time it must remain transparent and optically smooth. It does this by having a high rate of cell renewal and by the rapid removal of damaged cells from the epithelial surface. This is accomplished in the absence of a blood supply.

The epithelium is described as having layers made up of basal cells, wing cells and superfical cells. The healthy corneal epithelium has the following properties

1. It is highly transparent
2. It serves as a barrier to the entry of fluid into the corneal stroma.
3. It is resistant to shear forces.
4. It produces new cells and sheds old cells at a normal rate.

In this presentation I want to concentrate on the shedding of cells. There are at least four terms which describe this act: shedding, exfoliation, desquamation, and sloughing. They are generally used as synonyms without difference in meaning. The maintenance of cells is dependent on a balance between new cells produced by mitosis and old cells shed. In addition there is a centripetal movement of cells from the corneal limbus towards the corneal apex. This is necessary because the corneal stem cells are located at the limbus. These are the immortal mother cells of the corneal epithelium- the cells which can repopulate the epithelium even after every other cell is removed. The location of stem cells at the limbus protects them from ultraviolet damage.

Areas of shedding cells are visible clinically by means of stains such as fluorescein. It might be assumed that such areas of staining are sites where shedding has occurred, but more likely they are areas where shedding is about to occur. Once shed, cells are removed by the precorneal tears. However, not all cells in tears are ocular in origin. For example, first thing in the morning there are white blood cells - leukocytes. These can be obtained by irrigating the corneal surface with a corneal irrigating chamber.

What causes a cell to shed? Using the corneal irrigating chamber, we have shown in the human eye that a topical anesthetic (proparacaine) causes an increase in the number of cells shed. However, this is not inmediate, it requires several hours before there is an actual increase.

To investigate the factors which cause shedding in a controlled environment we had developed a procedure for maintaining rabbit corneas in isolation. This is necessary because it is likely that blinking is a major factor in the final removal of cells form the epithelial surface. By removing the effects of blinking we can study other factors which might influence shedding. Tear hyperosmolality has been suggested as one of the main causes of damage to the ocular surface in keratoconjunctivitis sicca (KCS) and dry eye. Is this damage caused by accelerating the shedding rate? When measured using the isolated cornea procedure we found no increase in cells shed - even with osmolalities as high as 420 mOsm/kg. Tear osmolality in KCS is only slightly higher than normal tears. Hence, there is no evidence that such relatively small differences could cause the magnitude of changes associated with dry eye - at last through the mechanism of increased shedding.

How about contact lens wear? Does anoxia affect the shedding rate? It does initially, but over a period of six hours there is no difference between a normoxic eye and an anoxic eye. Anoxia cannot

be the cause of the effect reported by Lemp et al. They reported that cells on the epithelial surface appeared larger in extented wear when viewed by specular microscopy.

One factor which is believed to increase shedding is over exposure to ultraviolet radiation. It is clear from the slide that the latent period for this shedding is very similar to the onset of discomfort. This suggests that shedding and discomfort are related, and fits with the widespread beller th the pain is due to exposure or nerve endings prematurely shed cells.

In summary we can say that cells do shed in t absence of blinking. The shear force exerted the lids is not the only factor which causes cells shed. Cell shedding is influenced by contact le wear. There is no evidence that the discomfort dry eye is due to an increase in cell shedding.