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Reactive membrane on a lens implant: three months after implantation*

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Abstract. Implant cytology study of a Leiske anterior chamber lens implant removed after three months because of corneal edema due to suspected endothelial damage during surgery revealed evidence of a fully developed membrane covering all of the implant at this early date. The cells in this membrane represented all the predominant cell elements seen in membranes on implants removed after years: foreign body giant cells, epithelioid cells, and fibroblast-like cells. However, the early stages of differentiation seen in the cells of the present membrane gave an indication that they are interrelated and have their origin in free-floating aqueous humor histiocytes.

Zusammenfassung. Zytologische Untersuchung eines Leiske Vorderkammer Linsenimplants, das nach drei Monaten wegen Hornhautoedems verursacht durch Endothelschaden entfernt werden mußte, ergab das Bestehen einer voll-entwickelten Membran auf dem Linsenimplant zu diesem fruehen Zeitpunkt. Die dominierenden Zelltypen, die in aelteren Membranen auf Linsenimplants Jahre nach deren Implantation gesehen werden, waren schon vorhanden: Fremdkoerperriesenzellen, Epithelioidzellen und fibroblastenartige Zellen. Doch die fruehen Entwicklungsstadien dieser Zelltypen zeigten, dass dieselben verwandt sind und wahrscheinlich aus im inneren Auge freibeweglichen Histiocyten entstehen.

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Lens implant cytology studies continue to reveal facts that indicate a surprising ability of the inner eye to effectively deal with and adjust to the foreign substance of implanted plastic lenses. A membrane forms to cover the surface of all parts of the implants, cells of different types and sizes take part in the formation of this membrane, and an effective separation of the foreign material from the fluids and tissues of the eye results. A definite difference between the orderly and purposeful formation of clear reactive mem-

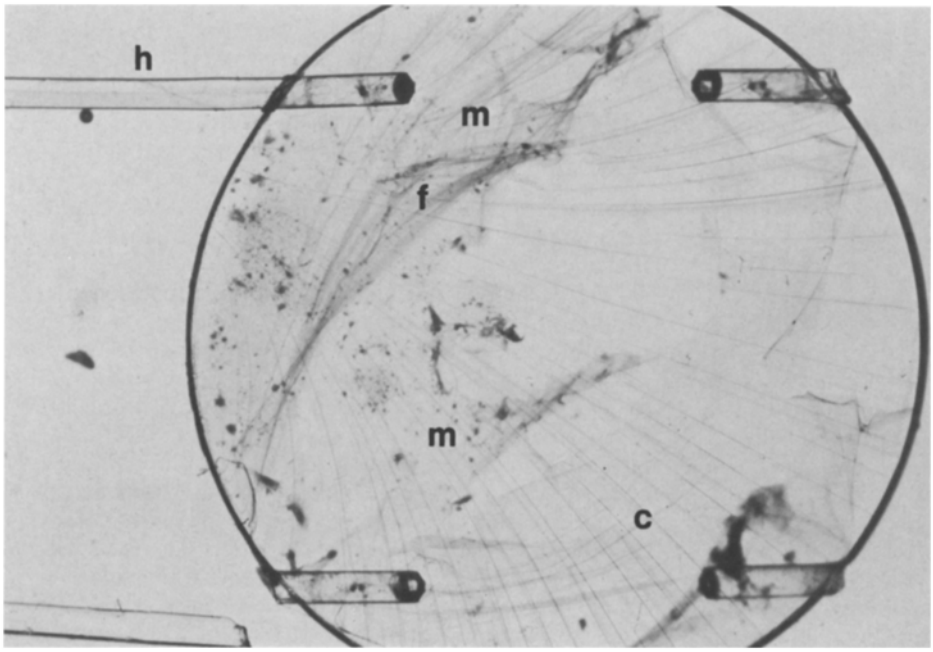

Fig. 1. Low power view of the whole implant with three of its haptics (*h*) cut. The membrane on the front surface (*m*) is folded towards the left (*f*) and it is partly missing. It contains numerous cells. The membrane on the back surface is more complete, but out of focus. Radiating lines represent artificial cracks (*c*) in the plastic surface of the implant. – Implant cytology technique, H and E stain, photomicrograph × 12,5

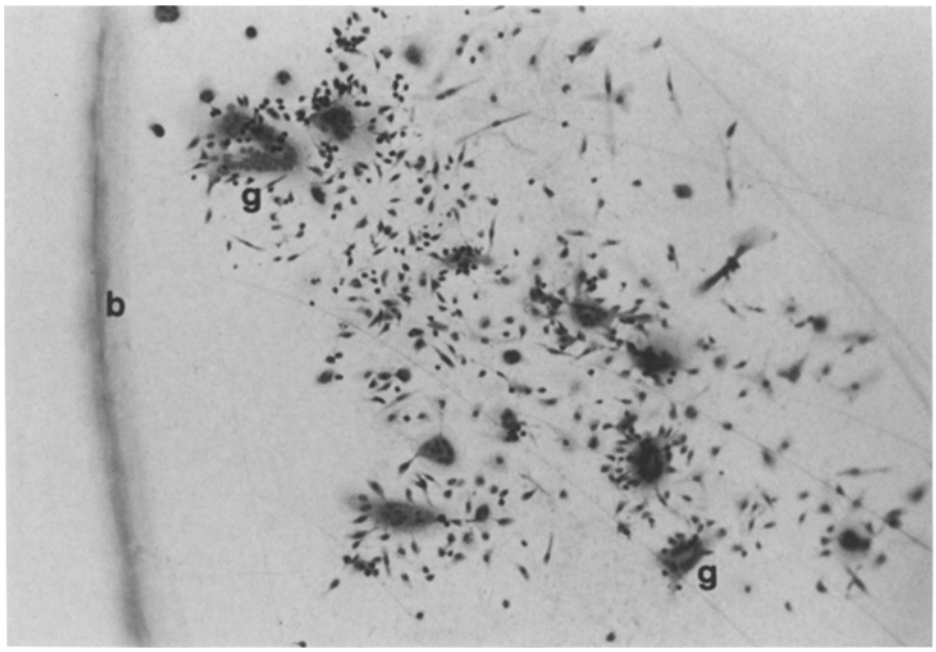

Fig. 2. Higher power of cells in the anterior membrane near the border of the implant (*b*). Fusiform and star-shaped fibroblast-like cells are the most numerous, but there also are many large and small foreign body giant cells (*g*). – Implant cytology technique, H and E stain, photomicrograph × 50

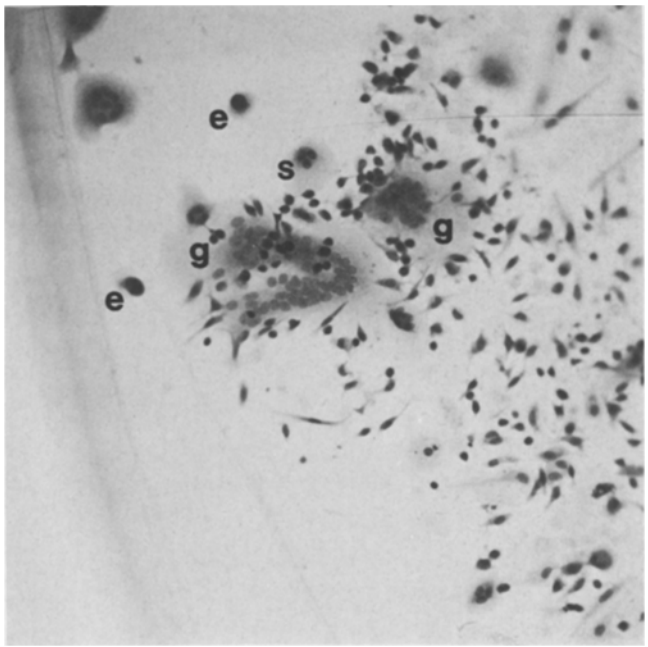

Fig. 3. Higher power of two large giant cells (*g*) seen in Fig. 2. There also are small giant cells (*s*) and epithelioid cells (*e*). The small cells to the right are mostly fibroblast-like cells, but there also are simple histiocytes and mononuclear round cells. – Implant cytology technique, H and E stain, photomicrograph × 100

branes covering a successful implant in contrast to scar-like or excessively pigmented membranes in complicated situations starts to take shape under the microscope of the observer, as more implants in more cases are studied with the lens implant cytology method [1–5].

It is suspected that successful lens implantation in eyes depends on the orderly formation of such membranes – and that there are great differences in the composition and arrangement of the cells in these membranes in different cases and at different times following the implantation surgery. To gain detailed insight into the process of the formation of these separating membranes and the composition of their cells at different stages is essential for progress. As a step on this road towards better understanding, the cytological composition of the earliest known cellular membrane on a lens implant removed 3 months after its implantation is demonstrated in the present paper.

Case report

This 75 year-old male had an intracapsular cataract extraction with placement of a Leiske anterior chamber implant in his left eye in June 1982. Postoperatively there were corneal complications almost from the start. The patient had severe corneal edema and a vision of finger counting in 3 feet, when he was first seen on the Corneal Service of this Eye Department in September 1982. A penetrating 8.0 mm keratoplasty and removal of the lens implant were done by Roger F. Meyer, M.D. on 9-27-82. Histological study of the corneal button revealed epithelial bullae, diffuse stromal edema, stromal scarring, and infiltration with PMN's, deep stromal vascularization with delicate thin-walled blood vessels directly next to Descemet's membrane superiorly, and much irregular loss of corneal endothelium.

When the anterior chamber lens was removed by Dr. Meyer, three of its supporting haptics were cut close to the optic portion (Fig. 1). The implant was fixed in 10% buffered Formalin immediately after its removal. Whole lens cytology staining revealed large parts of a thin membrane containing cells covering much of the implant (Fig. 1). The impression was that this membrane had covered all of the implant, but large portions had been lost during its removal. Additional smaller pieces were seen to float off during the staining process. The membrane in this case ruptured easily and was much more fragile than membranes on other implants which were all removed much later after their implantation.

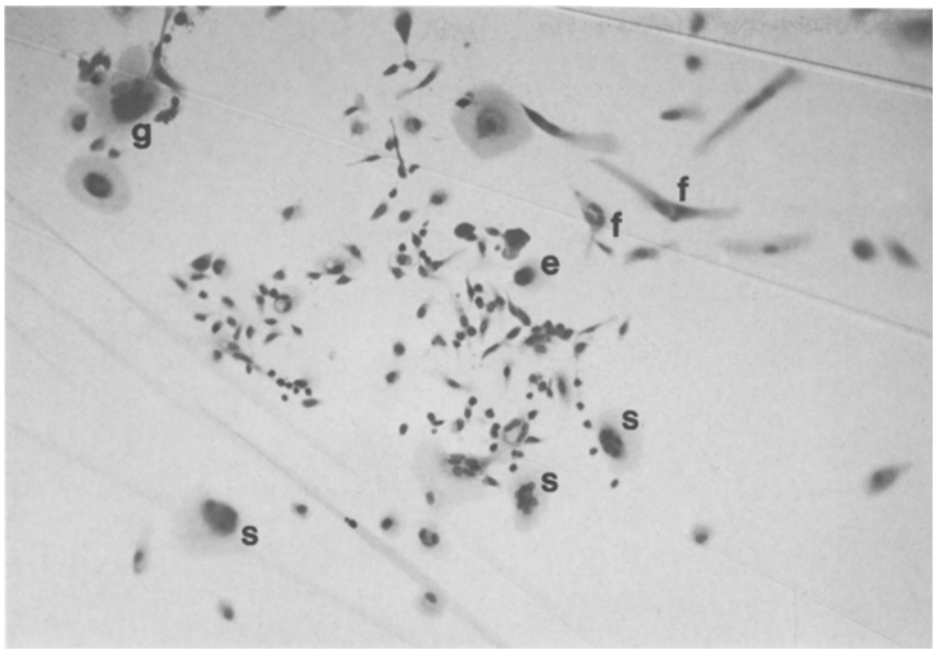

Fig. 4. High power of membrane showing epithelioid cells (*e*), small giant cells (*s*), one larger giant cell (*g*), and large fibroblast-like cells with several nuclei (*f*). Artificial cracks in the implant surface run straight across the view. – Implant cytology technique, H and E stain, photomicrograph × 100

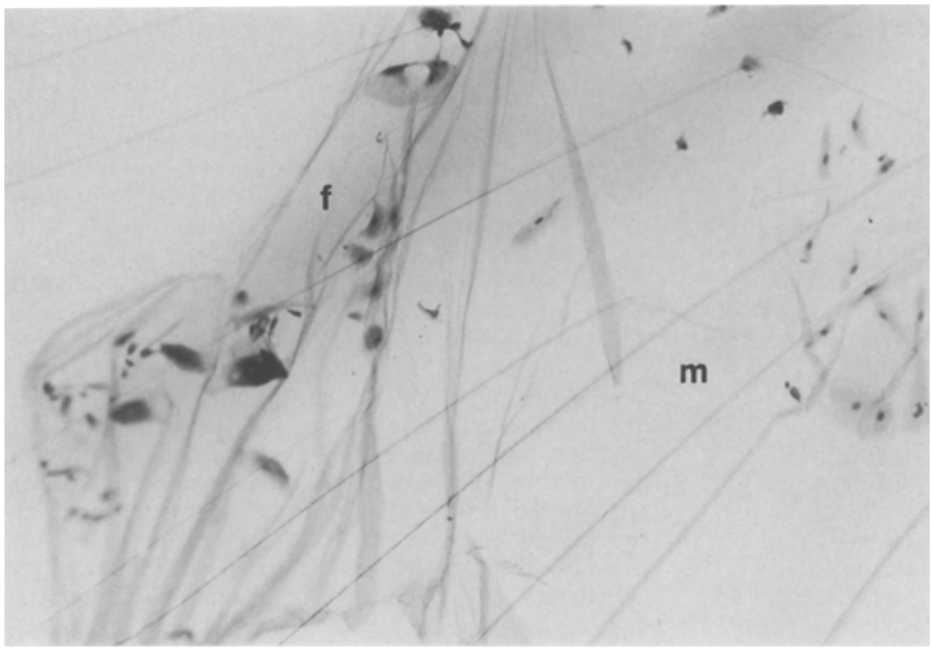

Fig. 5. Border of artificially folded membrane (*f*) with naked implant surface in upper left corner. The folded membrane contains a number of giant cells and a few fibroblast-like cells. On the right the membrane (*m*) is in place and contains typical fibroblast-like cells all the way to the right. – Implant cytology technique, H and E stain, photomicrograph × 50

Large parts of the membrane in the present case were still attached to the implant and undisturbed in the arrangement and composition of their cells (Fig. 2). These parts contained numerous cells of different sizes and shapes. Multinucleated foreign body giant cells were the largest of these. Some giant cells were quite extensive and contained up to about one hundred nuclei (Fig. 3). However, there also were many smaller giant cells with only a few nuclei next to typical epithelioid cells with only one nucleus. Interestingly, there also were multinucleated fusiforme and star-shaped cells (Fig. 4). In shape and cell type these otherwise resembled the elements that have been called fibroblast-like cells in earlier cases. However, the typical fibroblast-like cells with only one nucleus were also seen (Figs. 3 and 4). Finally, there were numerous small cells resembling active histiocytes and mononuclear smaller round cells with scarce protoplasm (Figs. 3 and 4). In portions, where the membrane had come loose from the surface of the implant, the wrinkled acellular parts of the membrane could be studied in detail (Fig. 5). This was rather regular in thickness and more eosinophilic than the membranes on implants removed later after implantation. The exposure of the implant to Xylol during the embedding process, by the way, had caused tiny cracks in the surface layer of its plastic. These cracks are seen as straight lines in some of the photographs (Figs. 1 and 5). It is important to state that there is no doubt in the mind of the examiner that the membrane had covered all of the implant and its haptics. On parts

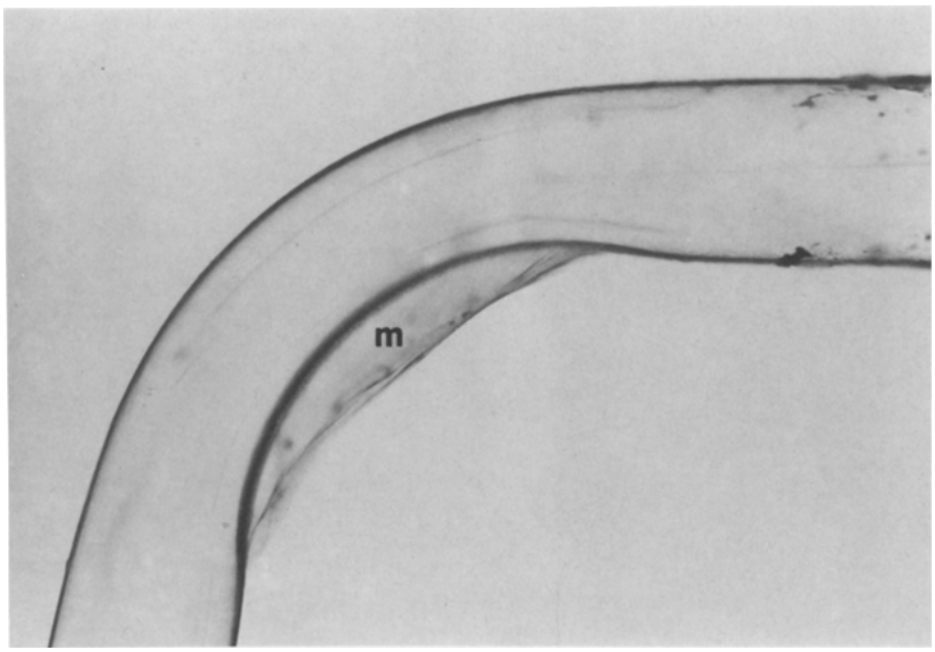

Fig. 6. The 90 degree bend in the one haptic still attached to the implant. This is ensheathed in the membrane that has come loose a little at the site of the bend (*m*). Cells contained in the membrane are not stained well and out of focus. – Implant cytology technique, H and E stain, photomicrograph × 50

of the haptics the membrane resembled a stocking that had come loose at the knee (Fig. 6). The membrane on the haptics also contained giant cells and small cells of different kinds similar to that on the optics.

Discussion

The histological study of the corneal button in the present case indicates that damage to the corneal endothelium had been done at surgery. This explained the corneal edema that developed soon after surgery and persisted. The implant was removed, when the corneal transplant was done for the edema. Implant cytology study showed that the implant was reasonably well accepted in the eye and that the usual process of adaptation by formation of a cellular membrane on its surface was already surprisingly complete at the early stage of three months after implantation. Study of the membrane in this early stage of its formation was a rare opportunity.

Three months after surgery the film-like acellular part of the membrane covering the implant was of a looser and more eosinophilic composition than membranes that have been studied on implants removed years after surgery [1–5]. Study of the cells in the membrane covering the present implant revealed a much more important fact: the different cell types that have already been observed on other implants were all present, but they all appeared to be less differentiated and clearly interrelated. Active histiocytes with short stubby processes were the most primitive of these interrelated cells in this membrane. Transitional stages of cells in their development from these simple histiocytes to epithelioid and giant cells as well as to star-shaped or fusiforme fibroblast-like cells were found. There even appeared to be some confusion in the early stages of the development of these cell types since some fibroblast-like cells did not quite seem to know which way to go in their differentiation and, thus, they exhibited the shape of fibroblast-like cells, but they contained several nuclei like a cell on its developmental way to become a foreign body giant cell.

These observations about a possible interrelationship and a common origin of the predominant cell types on lens implants greatly simplify a rather complicated cytological situation. There can be no doubt that fully developed membranes on lens implants contain different cell types with specific functions. The early stage of the present membrane indicates that most of these cells develop by differentiation from primitive histiocytes. These histiocytes [7–9] are known to move freely in the fluids of the inner eye and they certainly can settle on a lens implant. Histiocytes can become sessile and change into epithelioid cells. Epithelioid cells are well known to be the cytological precursor of foreign body giant cells. Our findings indicate that the same histiocytes can develop into fibroblast-like cells. These fibroblast-like cells have a phagocytic potential and are able to phagocytize whole erythrocytes on the implant surface [6]. These fibroblast-like cells can sometimes proliferate and take part in the formation of dense scar tissue somewhat like real fibroblasts under conditions that lead to the degeneration of the giant cells on the implants, for example [4]. Membranes on lens implants can also exhibit cells resembling iris melanocytes, pigment epithelium, or corneal endothelium under certain conditions, when the implant has been in place for years [1–5], but the present early stage of such a membrane did not exhibit any of these less common components. Thus, it can be concluded that these other cells are not all that important for the formation of the separating membrane on the implants.

The observation of a great potential for the primitive histiocytes to populate the surface of intraocular lens implants and to develop into a number of cell types with special functions is not very surprising. All mature tissues have such primitive cells for repair and adjustment and it seems that the role of the histiocytes in the eye only slowly starts to become apparent in its full value and its complexity. The very important question of the origin of the proteinaceous membrane on lens implants certainly still remains open. This membrane is very extensive in relation to the number of the cells contained in it. Every lens implant

has such a membrane and these wait for histochemical evaluation.

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