Electron-Microscopic Study of Pseudo-Exfoliation of the Lens Capsule

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Summary. The lens, iris, and ciliary body from the eyes of patients with glaucoma with cataract were examined via electron microscopy, and the following results obtained.

1. Zonular bundles were encrusted with accumulations of pseudoexfoliative (PE) materials and fragmented zonular fibrils, especially on their lateral aspects.
2. PE materials ranged from 300 to 400 Å in width, consisting of several subunits about 100 Å wide.
3. Pigment epithelial cells of the iris and nonpigmented epithelial cells of the ciliary process occasionally contained many phagosomes engulfing pigment granules.
4. Near the ciliary process, degenerating zonular bundles were mostly replaced with PE materials and fragmented zonular fibrils, and a gradual transition was observed between them.

From the above findings, it is probable that PE material might be mainly composed of degenerated zonular fibrils, which are presumed to be digested with lysosomal enzymes.

Introduction

Although there are some variations in the fine structure of the pseudoexfoliation syndrome, its morphologic changes around the lens, iris, and ciliary process are mostly carried out electron microscopically (Bertelsen et al., 1964; Ashton et al., 1965; Shakib et al., 1965; Bertelsen, 1966; Ghosh and Speakman, 1972, 1973, 1974; Dark et al., 1977).

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Concerning the pseudoexfoliative (PE) material, Dvorak-Theobald (1954) corrected the exfoliative material as a precipitate of accretion of unknown substance and called the condition 'pseudoexfoliation of the lens capsule,' which name is now in general use. Recently many examinations have been performed to pursue the source of PE material histochemically and electron microscopically, and considerable controversy has arisen as to the nature and origin of PE material.

The purpose of this study is to examine the lens, iris, and ciliary body taken from capsular glaucoma with cataract electron microscopically respecting a possible source of the PE material.

Materials and Methods

Three lenses from three patients (65, 66, and 85 years old) and three pieces of iris and ciliary process from three patients (73, 75, and 77 years old) who were afflicted with capsular glaucoma with cataract were obtained at operation. Lenses were extracted with a cryoprobe without using alpha-chymotrypsin and were dissected to obtain the equatorial region. The materials obtained were immersed in cold 2.5% glutaraldehyde in 0.1 M phosphate buffer at pH 7.4, post-fixed with 1% osmium tetroxide in the same buffer, dehydrated in a graded alcohol series, cleared in propylene oxide, and embedded in Epon. Thin sections were cut with a Porter-Blum ultramicrotome, stained with uranyl acetate and lead citrate, and examined with a JEM-100 C electron microscope.

Results

Lens Capsule

The lens capsule was well preserved, showing almost normal structures. The superficial layer was less compact, especially in association with PE materials. At the attachment of the zonular fibrils to the lens capsule, there was always a great accumulation of PE materials consisting of several subunits about 100 Å in width. Zonular bundles were encrusted with accumulations of PE materials and fragmented zonular fibrils, especially on their lateral aspects. Some PE materials appeared to form in close association with fragmented zonular fibrils (Fig. 1). The zonular lamella was mostly obscured because of accumulation of the dense PE materials. Embedded in the surface layer of the capsule, zonular bundles, and PE materials were a few membrane-clad organelles, most of which were clearly identifiable as pigment granules. Intertwined PE materials invaded deep into the capsule obliquely and perpendicularly to the surface (Fig. 2).

Iris

The normal anterior surface of the iris consisted of a loosely arranged meshwork of melanocytes separated by clear spaces containing occasional fine fibrils. Contrarily, numerous PE materials and fragmented fine fibrils were mixed, covering the posterior