Subretinal “Napkin-Ring” Membrane in Proliferative Vitreoretinopathy

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A “napkin-ring” subretinal membrane is an unusual expression of subretinal proliferation associated with retinal detachment. An 80-year-old man with a total funnel-shaped retinal detachment underwent pars plana vitrectomy, 360° relaxing retinotomy, excision of a subretinal napkin-ring membrane, and silicone oil injection. Histopathologic examination of the removed napkin-ring subretinal membrane revealed the presence of retinal pigment epithelium (RPE) as the major source of cells within the membrane. Myofibroblasts were the most common cellular constituents; the total number of these cells may have correlated with the degree of clinical contraction, causing a funnel-shaped retinal detachment.

Proliferative vitreoretinopathy (PVR) is the most common cause of failure after retinal detachment surgery. Proliferative vitreoretinopathy is defined as a continuum of increasing abnormalities that involves the growth and contraction of cellular membranes on 1 or both surfaces of the retina. The Silicone Study classified PVR into focal or diffuse posterior PVR, subretinal PVR, and anterior PVR with circumferential, perpendicular, or anterior contraction.1,2 Severe circumferential contraction of an annular “napkin-ring” subretinal band may produce a characteristic funnel-shaped total retinal detachment.

The purpose of the current report is to describe a patient with a total funnel-shaped retinal detachment with subretinal napkin-ring PVR and the pathology of the excised napkin-ring membrane.

REPORT OF A CASE

An 80-year-old man had persistent retinal detachment and PVR in the right eye. The ocular history of his right eye included 4 operations: (1) cataract surgery with implantation of a posterior chamber intraocular lens; (2) scleral buckling procedure, pars plana vitrectomy, fluid/air exchange, endolaser, and C3F8 gas injection; (3) repeated pars plana vitrectomy, membrane peeling, fluid/air exchange, endolaser, and C3F8 gas injection; and (4) a revision of the scleral buckle and perfluoropropane gas injection 2 months previously. On our initial examination, the visual acuity was 1/200 OD and 20/30 OS. Anterior segment biomicroscopy of the right eye showed a clear cornea, a deep anterior chamber with a mild inflammatory reaction, a well-positioned posterior chamber intraocular lens, and an intraocular pressure of 8 mm Hg. A total funnel-shaped retinal detachment with advanced PVR and a faintly visible subretinal napkin-ring membrane were present (Figure 1).

At the time of the vitrectomy of the right eye, a 360° relaxing retinectomy posterior to the buckle was performed and a pigmented, napkin-ring subretinal band was removed as a single band-shaped membrane. Perfluorocarbon liquid was used to reattach the retina. This was followed by endolaser photocoagulation, removal of the perfluorocarbon liquid during a fluid/air exchange, and injection of 1000 centistokes of silicone oil. Complete retinal reattachment was achieved. The retina has remained reattached and the visual acuity with best correction was 20/400 at the last follow-up visit 1 year after surgery (Figure 2).
Figure 1. Representative digitized schematic showing total funnel-shaped retinal detachment with subretinal “napkin-ring” membrane (dotted line).

Figure 2. Fundus photograph of posterior pole following retinal reattachment surgery. Note silicone oil reflexes superior to the optic disc and inferior to the macula.

Figure 3. A, Histopathologic examination reveals fibrocellular connective tissue with pigmented cells (between arrowheads) and spindle-shaped cells (arrow) interposed between fibrin and collagen lamellae (hematoxylin-eosin, original magnification ×250). B, Immunohistochemical stain showing retinal pigment epithelium (RPE) (asterisk) with focal staining for smooth muscle actin (arrowhead, red staining) and profiles of spindle-shaped cells (myofibroblasts) with red staining (arrows) (original magnification ×250). C, Immunohistochemical stain showing focal staining for S100 protein (red staining) in pigmented cells (RPE). Note the absence of staining in the spindle-shaped cells (asterisk) (original magnification ×250). D, Immunohistochemical stain showing focal staining for keratin (red staining) in pigmented cells (RPE) (original magnification ×250).
Gross examination of the subretinal membrane revealed a thin linear piece of tissue measuring 6 x 1 mm with focal pigmentation. Microscopic examination revealed fibrocellular connective tissue with pigmented cells and spindle-shaped cells interposed between fibrin and collagen lamellae (Figure 3, A and B). Immunohistochemical stains for S100 protein, glial fibrillary acidic protein, cytokeratin, and smooth muscle actin were performed.

Retinal pigment epithelium (RPE) was the most common source of cells within the membrane. Three cell types apparently derived from RPE (all positive for S100 and cytokeratin) were identified (Figure 3, C and D). The first cell type consisted of highly differentiated cuboidal cells with intracytoplasmic pigmented granules (epithelial-like cells), arranged in clumps and, in some areas, in a tubulocinar configuration. The second cell type included pigmented macrophages arranged in clumps or scattered within the membrane, identified as large round cells containing variable amounts of melanin. The third cell type included spindle-shaped, fibrocyte-like cells which were slightly pigmented or nonpigmented, and formed strands of densely packed cells 3 to 5 cell layers thick in the central aspect of the membrane. Many of these cells were intensely positive for smooth muscle actin, pointing to myoblastic differentiation of the RPE cells (Figure 3, B). Fibrocyte-like RPE cells (positive for S100 and cytokeratin) and fibrous astrocytes (positive for glial fibrillary acidic protein) contributed approximately equally to the total number of myofibroblasts. The myofibroblasts (positive for smooth muscle actin) outnumbered all other cells and represented the most common cell subpopulation within the membrane (Figure 3, B).

**COMMENT**

In eyes with long-standing retinal detachment, new cells appear and proliferate along the inner and outer surface of the retina, in the vitreous cavity, and on the posterior surface of the lens. Formation of a cellular membrane on the outer surface of the retina can occur after any type of retinal detachment (rhegmatogenous, tractional, or exudative) and is present in up to 47% of cases undergoing vitrectomically surgery. The incidence increases with the duration of retinal detachment and ranges from 0.8% in cases present for less than 1 month to 22% in cases estimated to be present for more than 2 years.

Subretinal membranes rarely require surgical treatment unless they prevent successful retinal reattachment. A napkin-ring subretinal membrane is an unusual expression of subretinal proliferation. This type of membrane, located adjacent to the optic nerve, holds and confines the retina in a funnel shape. Only a few histopathological cases of this type of membrane have been reported.

Subretinal membranes are composed of transdifferentiated RPE cells, glial cells, fibroblasts, myofibroblasts, and inflammatory cells. After retinal detachment, RPE can migrate to the outer retinal surface and differentiate into macrophages. Retinal pigment epithelium may also transdifferentiate into cells histologically similar to a fibrocyte, capable of continuous multiplication and collagen synthesis. After active proliferation, differentiation of macrophages (originally derived from RPE) into epithelial-like cells (more normal-appearing RPE cells) is suspected to occur. Epithelial-like cells appear late in retinal detachment, resemble normal RPE cells, and do not appear to proliferate further.

GliaI cells contribute to the formation of subretinal membranes. Glial cells can migrate and proliferate through focal interruptions in the external limiting membrane of the retina. It is believed that glial cells are present in subretinal membranes only in long-standing retinal detachments. Degeneration of neural elements might be one of the stimuli for glial proliferation and occurs as early as 3 weeks after a retinal detachment.

In the current case, a large number of myofibroblasts were present within the membrane (Figure 3, B). Myofibroblasts are cells with characteristic features of both fibroblasts and smooth muscle cells. Several studies reported the presence of myofibroblasts in PVR and proliferative diabetic retinopathy, and concluded that they might be responsible for vitreoretinal traction. This patient had a markedly folded and detached retina in a closed funnel-shaped configuration. The presence of a large number of myofibroblasts and the extent of actin stain probably played an important role in the development of the napkin-ring membrane and may have correlated with the degree of clinical contraction.

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**REFERENCES**