Anterior Segment Implantation Cysts

Ultrasound Biomicroscopy With Histopathologic Correlation

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Objective: To correlate the clinical, histopathologic, and ultrasound biomicroscopic characteristics of anterior segment implantation cysts.

Methods: We performed a retrospective review of 7 cases of secondary anterior segment implantation cysts. We reviewed the clinical history, visual acuity, clinical findings, and ultrasound biomicroscopic characteristics in all cases. Histopathologic correlation was possible in 4 cases.

Results: Six eyes had been subjected to major trauma prior to cyst formation. Trauma was noted as blunt in 3 eyes and surgical in 3 eyes. The diagnosis was confirmed in 1 eye when conjunctival cells were aspirated on fine needle biopsy. Ultrasound biomicroscopy revealed large (mean ± SD greatest diameter, 4.7 ± 0.9 mm) cystic tumors. In 1 patient, a cyst-related indentation of the anterior lens surface was seen. Ultrasonographic evaluations of internal reflectivity revealed thick, moderately reflective cyst walls encapsulating a relatively hypoechoic core. In 3 cases, the cyst contents consisted of variably reflective material. The other 4 were completely sonolucent. Histopathologic correlation showed that the cyst walls were lined with stratified squamous epithelium. The moderately reflective cyst contents were found to be degenerated conjunctival cells with inflammatory foci and cholesterol crystals. The sonolucent regions correlated with inflammatory cells and fluid.

Conclusions: This study demonstrates that implantation cysts are unilateral, large, and thick walled. They may be sonolucent or exhibit variable internal reflectivity. These findings as well as the extent of anterior segment involvement (particularly posterior extension) could be evaluated by ultrasound biomicroscopy prior to surgery.


Cystic lesions occurring within the anterior segment may be classified as primary or secondary.1 Primary cysts are of neuroepithelial origin, while secondary cysts occur as the result of implantation, metastatic or parasitic lesions, or after long-term use of miotics.1 Implantation cysts result from implantation of epithelial cells on the iris after penetrating or surgical trauma, which may lead to a solid (pearl) mass, a fluid-filled (serous) cyst, or epithelial ingrowth.1-6 Such lesions can, in turn, cause corneal edema, uveitis, glaucoma, and decreased visual acuity.1-3,5-7

Ultrasound biomicroscopy (UBM) has become indispensable for evaluating anterior segment tumors and cysts, including those undetectable by slitlamp biomicroscopy or conventional waterbath ultrasonography.8-10 However, accurate interpretation of ultrasound images relies on established correlations among anatomy, histologic study, and ultrasound images—both normal and abnormal. As of yet, very few such correlations have been performed.8,10,11 The purpose of this article is to provide further correlations.

REPORT OF CASES

CASE 1

An 88-year-old man was referred for evaluation of a mass in his right eye (Figure 1). He had previously undergone extracapsular cataract extraction with posterior chamber implantation in that eye.

Uncorrected visual acuity was 20/25 OD, intraocular pressure (IOP) was 20 mm Hg OD. Ophthalmic examination revealed a shallow anterior chamber and anterior iris convexity from the 1- to 4-o’clock positions. Transillumination suggested a cystic lesion. On gonioscopy, the mass obscured visualization of the anterior chamber angle, which was otherwise open. The posterior segment was nor-
PATIENTS AND METHODS

Ultrasound biomicroscopy was performed using a commercial unit (model 840, Humphrey-Zeiss, San Leandro, Calif). This system operates at 50 MHz, providing a maximum resolution of 50 µm and a tissue penetration depth of approximately 4 to 5 mm. The scanner produces a 5 × 5-mm field with 256 image lines at a scan rate of 8 frames per second. The probe is suspended from an articulated arm to reduce motion artifacts, and lateral distortion is minimized by a linear scan format. Scanning was performed with the patient in the supine position, using a 20-mm eye cup filled with saline solution. The probe was moved perpendicular to the structure to be scanned to produce radial and transverse sections. Following surgical excision, the cysts were immediately fixed in 10% formalin for 24 hours. After routine processing, paraffin sections were prepared and stained with hematoxylin-eosin. Photomicrographs were prepared in comparable planes of view and magnification to correlate with the previously obtained UBM images.

We report on the UBM evaluations of 7 patients with anterior segment cysts. Histopathologic reports were available for 4 eyes.

The clinical, UBM, and histopathologic features of the cases studied are summarized in Table 1 and Table 2 and in the figures.

ultram. Ultrasound biomicroscopy revealed a round cyst (radial diameter, 3.1 mm; height, 2.7 mm) attached to the posterior surface of the midperipheral and pupillary iris. Serial radial scans of the lesion revealed that the cyst content was sonolucent, except from the 3- to 4-o’clock positions, where moderately echoic material with a hyperechoic core that adhered to the cyst wall was seen (Figure 1, A and B). During the following 9 months, the lesion grew and eventually was removed by sector iridectomy. During surgery, calcific or cholesterol-type deposits along with mucoid material that extended into the anterior chamber were found. This material was later removed by irrigation. Two months after surgery, visual acuity was 20/40 OD; IOP was 10 mm Hg OD. Pathologic examination of the excised iris (Figure 1, C) revealed that the cyst wall was composed of a stratified epithelial lining. The cyst cavity was filled with inflammatory debris. The cyst adhered to the iris.

CASE 2

A 42-year-old man was referred to us because of a cystic lesion in the left eye (Figure 2). Thirteen years previously, he had had perforating trauma, which was surgically repaired in the Dominican Republic. Two months previously, his eye became inflamed, and he was treated with topical antibiotics and steroids, which were ineffective.

Visual acuity was 20/50 OS; IOP was 16 mm Hg OS. Ophthalmic examination revealed diffuse conjunctival hyperemia (1+ to 2+) and a full-thickness central linear scar extending from limbus to limbus in the horizontal meridian, from approximately the 9:30- to 2:30-o’clock positions. The cyst extended from approximately the 1- to 4-o’clock position. It was apparently located in the iris stroma, which was compressed and thinned by the lesion. A superficial vessel ran superiorly to the periphery of the cyst. The anterior chamber was shallow superiority with a mild cellular reaction, but was otherwise deep. The inferior half of the lens could be seen after dilation and appeared to be clear. In the meridians where the cyst was located, visualization of the angle structures was prevented by the cyst; elsewhere, gonioscopy revealed a grade 4 angle. There were no fundus abnormalities.

As the cyst was covering the visual axis, we attempted to remove it with 5 Nd:YAG laser applications of 1 to 2 mJ. After the procedure, the cyst deflated and moved superiorly under the edge of the pupillary margin. The anterior chamber became deeper nasally and temporally, and visual acuity improved subjectively. Three weeks later, visual acuity was 20/30 OS; IOP was 19 mm Hg OS. Slitlamp biomicroscopy revealed a small remnant of the cyst at the superior border of the pupillary margin.

In March 1997, the cyst returned and pushed the atrophic iris forward, shallowing the anterior chamber superiority. Visual acuity was hand motion OS and keratometry was 43.00/49.00 with very poor mires. Ultrasound biomicroscopy revealed a cyst (radial diameter, 3.8 mm; height, 2.7 mm) located in the iris stroma and extending from approximately the 10- to 3-o’clock position (Figure 2, A). The cyst cavity was almost completely sonolucent. The patient underwent anterior chamber reconstruction with penetrating keratoplasty, cataract extraction without intraocular lens implantation, cyst excision, anterior synechialysis, and anterior vitrectomy. Five months later, visual acuity was 20/100 OS. The graft was clear and a large iridectomy was located between the 10-o’clock and 3-o’clock positions.

Pathologic examination revealed a cyst with nonkeratinized squamous epithelial lining. The cyst cavity was partially filled with inflammatory cells and epithelial debris. The wall contained localized collagenous thickening. The iris stroma was atrophied due to compression by the cyst (Figure 2, B).

Table 1. Clinical Features of Male Patients With Implantation Cysts

<table>
<thead>
<tr>
<th>Patient No./Race/Age, y</th>
<th>Eye</th>
<th>Origin</th>
<th>VA</th>
<th>IOP, mm Hg</th>
<th>Location</th>
<th>Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/W/88</td>
<td>OD</td>
<td>ECCE/PCIOL</td>
<td>20/25</td>
<td>20</td>
<td>PC</td>
<td>1-4</td>
</tr>
<tr>
<td>2/H/42</td>
<td>OS</td>
<td>Trauma</td>
<td>20/50</td>
<td>16</td>
<td>AC</td>
<td>10-3</td>
</tr>
<tr>
<td>3/W/69</td>
<td>OS</td>
<td>ECCE/PCIOL</td>
<td>20/20</td>
<td>16</td>
<td>I</td>
<td>9</td>
</tr>
<tr>
<td>4/W/13</td>
<td>OS</td>
<td>Congenital</td>
<td>20/20</td>
<td>15</td>
<td>PC</td>
<td>6:30</td>
</tr>
<tr>
<td>5/W/52</td>
<td>OD</td>
<td>Trauma</td>
<td>20/20</td>
<td>16</td>
<td>AC</td>
<td>4-8</td>
</tr>
<tr>
<td>6/H/73</td>
<td>OD</td>
<td>ECCE/PCIOL</td>
<td>LP</td>
<td>30</td>
<td>AC</td>
<td>11-2</td>
</tr>
<tr>
<td>7/H/58</td>
<td>OD</td>
<td>Trauma</td>
<td>16</td>
<td>14-30</td>
<td>CF</td>
<td>1-4:30</td>
</tr>
</tbody>
</table>

*VA indicates visual acuity; IOP, intraocular pressure; position, of the cyst according to the meridian (clock hours); w, white; ECCE/PCIOL, extracapsular cataract extraction/posterior chamber lens implantation; PC, posterior chamber; H, Hispanic; HM, hand motion; AC, anterior chamber; I, iris; LP, light perception; and CF, counting fingers.

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CASE 3

A 69-year-old man underwent extracapsular cataract extraction with posterior chamber implantation in his left eye (Figure 3). Approximately 9 months later, a white spot was noted in the midperiphery of the iris at the 9-o’clock position. Visual acuity was 20/20 OS; IOP was 16 mm Hg OS. The lesion enlarged progressively and uveitis developed; this was unresponsive to treatment with topical steroids (1% prednisolone acetate every 6 hours). Ultrasound biomicroscopy revealed a round, cystic lesion (radial diameter, 3.1 mm; height, 2.6 mm) in the iris stroma filled by material of medium-to-low acoustic reflectivity with a central, highly reflective core (Figure 3, A). Fine needle aspiration biopsy revealed acute and chronic inflammatory cells with mucoid material, benign exfoliated squamous epithelial cells, and occasional goblet cells. The cyst was excised surgically and the uveitis gradually improved. Pathologic examination revealed a cyst with stratified squamous cell lining filled with proteinaceous fluid and degenerated epithelial cells. The iris stroma was infiltrated by acute and chronic inflammatory cells (Figure 3, B).

CASE 4

A 13-year-old boy was referred for evaluation of an iris spot in the left eye (Figure 4). Findings from a previous ophthalmic examination 14 months earlier were normal. Visual acuity was 20/20 OS; IOP was 15 mm Hg OS. Ophthalmic examination revealed a quiet eye with a clear cornea. An iris cyst at the 6:30-o’clock position caused thinning of the anterior iris stroma and allowed visualization of the cyst cavity, which was transparent. The lens was clear. Fundus examination was normal. Ultrasound biomicroscopy revealed a cyst (radial diameter, 4.8 mm; height, 2.8 mm) on the posterior iris surface with thick walls and containing multiple small particles of intermediate reflectivity in an otherwise echolucent cavity (Figure 4, A). The cyst compressed the ciliary body and minimally indented the anterior lens surface. Six months later, the cyst appeared larger and pupillary distortion was noted.

A 30-gauge needle on a 1-mL tuberculin syringe was used to evacuate the contents of the cyst by manual aspiration until the anterior and posterior walls were completely collapsed as visualized by UBM. Because the wall of the cyst was directly apposed to the surgical limbus, the needle was passed through the posterior limbus into the most peripheral portion of the cyst, in the hope that as the cyst collapsed, the peripheral portion of its wall would remain in contact with the inner limbus until the end of the procedure, minimizing the possibility of leakage of the cyst contents into the anterior chamber. Argon laser photocoagulation (25 bursts, 0.1 second, 250-300 mW) was applied to the iris surface in an attempt to seal the cyst. Pathologic examination of the aspirated fluid revealed rare, exfoliated, nonkeratinizing squamous cells with occasional macrophages and melanin pigment (Figure 4, B). There was no evidence of inflammation or malignancy, and the lesion was diagnosed as an epithelial inclusion cyst, presumably congenital. After the procedure, the patient recovered uneventfully, and the cyst has not recurred.

CASE 5

A 52-year-old man had perforating trauma in his right eye surgically repaired at 4 years of age (Figure 5). Four years later, a second procedure was performed to remove scar tissue. Ten years later, an optical iridectomy was performed. In 1997, a mass was noted on the inferior iris. Elevated IOP developed. When first examined by us, visual acuity was hand motions OD; IOP was 16 mm Hg OD. There was a right exotropia with full motions in both eyes. There was a corneal inferior stromal opacity, and a large, translucent cyst touching the corneal endothelium was seen on the inferior iris. The pupil was irregular and there was an iridectomy superiorly. Gonioscopy revealed a large cyst closing the angle inferiorly; otherwise, the angle was grade 3. A large peripheral anterior synechia was present near the old surgical wound superiorly. Ultrasound biomicroscopy imaged an ovoid, nonloculated cyst (largest diameter, 5.3 mm; height, 3.2 mm) with a hypoechoic core extending from the 4- to 8-o’clock positions (Figure 5). The cyst did not recur on subsequent observation.

CASE 6

A 68-year-old man complained of pain in the right eye 2 years after undergoing extracapsular cataract extraction...
with posterior chamber implantation (Figure 6). Visual acuity was 20/100 OD; IOP was 60 mm Hg OD. Ophthalmic examination revealed moderate hyperemia, corneal microcystic edema, cells (2+) in the anterior chamber, and a lobulated epithelial cyst behind the iris extending from the 11- to 2-o’clock position. The IOP was lowered medically. Gonioscopy revealed that the superior angle was closed and heavily pigmented. The patient was discharged from the hospital to allow the eye to quiet before excising the cyst, but did not return for 4 years; at this point he had taken no medications for 2 years. Visual acuity was now light perception OD; IOP was 30 mm Hg OD. There was corneal microcystic edema with a superior cyst and mild flare in the anterior chamber. Ultrasound biomicroscopy showed a cystic lesion (radial diameter, 4.6 mm; height, 2.8 mm) with thick walls, a hypoechoic content, and internal septa (Figure 6). Gonioscopy showed the cyst wall touching the angle superiorly. The patient was again lost to follow-up.

**CASE 7**

A 58-year-old man complained of decreasing visual acuity in the right eye (Figure 7). Fifteen years previously, he had suffered an injury in that eye, with a lac-
eration above the upper right eyelid. Two years earlier, he had been told of a cyst in that eye. Visual acuity was counting fingers at 3 ft OD, IOP was 16 mm Hg OD, and the eye was exotropic. Ophthalmic examination revealed a cyst in the iris periphery extending from the 1- to 4:30-o’clock positions. The cyst had translucent, poorly pigmented walls and a transilluminated well. It appeared to be divided by septa at the 3-o’clock position. The pupil was eccentric, the angle was open, and indirect ophthalmoscopy findings were normal. Ultrasound biomicroscopy revealed a cyst (radial diameter, 3.4 mm; height, 2.9 mm) with thick walls and hypoechoic contents (Figure 7) in the iris stroma, which compressed the thinned layers of the iris.

**COMMENT**

Implantation of epithelial surface cells from the cornea, conjunctiva, or skin may occur by entrance of these cells into the eye during surgical or perforating trauma or through a poorly closed surgical wound. Prolonged postoperative hypotony or incarceration of the iris or lens capsule are considered risk factors.⁵⁻⁶,¹² Although normal aqueous humor is supposed to inhibit growth of these cells, the iris provides an adequate environment for cell proliferation.¹³ Three types of proliferation are classically recognized: (1) pearl cyst, (2) serous cyst, and (3) epithelial ingrowth.
Pearl cysts are rare and consist of small, white, solid tumors with opaque walls located in the iris stroma and not connected to the wound.\textsuperscript{6,14} Serous, translucent cysts are more common; they can be either connected to the wound or located far away from it.\textsuperscript{9} They can erode through the iris and invade the posterior chamber. Their growth rate is variable; they can grow for awhile and then suddenly become stationary. Epithelial ingrowth consists of an epithelial, semitransparent, avascular membrane that progresses on the posterior surface of the cornea,\textsuperscript{6,14} the trabecular region, and the iris surface. As a consequence, corneal deep vascularization and secondary glaucoma may develop. The glaucoma is usually intractable and may lead to blindness or loss of the eye.\textsuperscript{6,14}

Finger et al\textsuperscript{1} described the first pearl cyst to be imaged by UBM. This case corresponded to case 3 of our series. Pearl cysts are imaged as solid round to ovoid tumors containing 3 concentric layers. The external layer has moderate reflectivity and correlates with the cystic epithelial lining. The intermediate layer has lower reflectivity corresponding to degenerated epithelial cells, mucus, and inflammatory debris. Finally, a central high reflective core correlates to keratinous debris collected in the center of the cyst contents and cholesterol crystals derived from degenerative keratinized cells.\textsuperscript{1}

Echolucent cysts are always unilateral and are usually located in the iris or ciliary body stroma.\textsuperscript{10} They tend to have large diameters that cause iris atrophy by compression. These cysts are typically imaged as round or elliptic lesions with thick walls and a sonolucent cavity.\textsuperscript{10} Occasionally, dense fluctuating particles are seen in the cystic cavity (case 4). As previously described, we also found that most of these cysts are not septate. Four of the 7 lesions in our series were located predominantly in either the superior or inferior quadrants of the iris.

We confirmed by histopathologic study that most of these cysts have thick walls due to their nonkeratinized squamous stratified epithelial cell lining and that their sonolucent cavities are filled with fluid and degenerated epithelial cells. Echolucent material with a hyperechoic core, as seen in pearl cysts, can be observed in the cavity adherent to its internal surface, as seen in case 1. This particular case illustrates that intermediate forms between pearl cysts and serous cysts can occur and that they may represent different phases of cystic evolution that vary according to the ocular environment.

One of our patients (case 3) had a congenital nonpigmented iris cyst. These cysts are particularly rare.\textsuperscript{15} They are seen as translucent cysts in the middle or periphery of the iris and tend to enlarge and their pathogenesis remains controversial.\textsuperscript{7,15} Entrapment of surface epithelium inside the eye during lens vesicle separation may be the cause.\textsuperscript{7} Ultrasound biomicroscopy images of these cysts were no different from images of other implantation cysts.

Photocoagulation has been used to puncture\textsuperscript{16,17} and shrink\textsuperscript{18} epithelial cysts. Multiple treatments may be required and despite treatment, recurrences are frequent. Producing a hole in the wall of an epithelial cyst may externalize it, thereby converting it into a sheetlike epithelial ingrowth.\textsuperscript{14}

In conclusion, UBM provides useful information concerning surface and internal characteristics of secondary cysts in the eye. Implantation cysts are large, thick-walled cysts filled either by hypoechoic material corresponding to fluid and degenerated epithelial cells or by medium-echoic material with a hyperechoic core that corresponds to inflammatory debris and cholesterol crystals. Although it was not essential in our cases, UBM also allows for an evaluation of the posterior extent of these tumors. Knowledge of ciliary body or haptic involvement prior to surgery might influence treatment.

\textbf{Accepted for publication July 3, 1998.}

This study was supported by the New York Glaucoma Research Institute, New York; New York Eye and Ear Infirmary Departments of Pathology and Ophthalmology Re-
REFERENCES


A look at the past . . .

Dr. Kruckmann (Leipzig). On the pathogeny of choked disc.

The author is of the opinion that, with the exception of agents furnished by animal parasites, the material necessary for production of a choked disc must be furnished by the cells of the human body itself. These cells he calls purulentogenous, somatogenous, or autogenous, and refers their origin to hypertrophic material, produced by the destruction of cells. He also relies on the form of the exudate, which is chiefly fluid, to explain the disproportion which exists between the slight functional disturbance and the stormy appearances often seen in the papilla itself. The causes of choked disc are autonomous tumors, tuberculosis, syphilis, and parasites. The occurrence of papillitis in intracranial processes is favored by anatomical connections of the peripheral terminations of the optic nerve with the central organ; and by increased cerebral pressure; it is a papillary inflammation; the inflammatory matter is somatogenous or autogenous when vision is slightly disturbed, but such an origin of the inflammatory material does not always explain the slight functional disturbance.

Leber remarked that he had offered the same theory some years ago and was glad to see it taken up again.