Bilateral Anterior Lenticonus

Scheimpflug Imaging System Documentation and Ultrastructural Confirmation of Alport Syndrome in the Lens Capsule

Anna K. Junk, MD; Fritz H. Stefani, MD; Klaus Ludwig, MD

Background: Alport syndrome is a combination of proteinuria, hematuria, and neurosensory high-frequency deafness. Bilateral anterior lenticonus may be a late sign. Diagnosis relies on characteristic electron microscopy changes of glomerular basement membranes in renal biopsy specimens.

Patient: A 38-year-old man was seen for progressive visual acuity loss (20/400 OU; best-corrected visual acuity, 20/60 OD and 20/50 OS). Findings from slitlamp examination included bilateral anterior lenticonus and central posterior subcapsular cataract, documented using a modified Scheimpflug imaging system. Retinal pathology was not present. On detailed questioning, a history of microhematuria and proteinuria since childhood and progressive high-frequency deafness for years were discovered. The family history was negative for nephropathies, deafness, or eye diseases. Cataract extraction rehabilitated the patient’s vision.

Results: Electron microscopy of a fragile capsulorhexis specimen showed typical thinned basal lamina with basement membrane disruptions.

Conclusions: Anterior lenticonus is a rare bilateral progressive developmental anomaly. More than 90% of cases are associated with Alport syndrome. For diagnosis of Alport syndrome, the presence of 3 of 4 criteria is required: family history positive for Alport syndrome, progressive intra-auricular deafness, characteristic eye anomalies, and positive findings from glomerular ultrastructural examination. We believe that ultrastructural proof of anterior lenticonus may also be provided in the lens capsule.


ALPORT SYNDROME is a hereditary progressive disease that afflicts the kidneys and the auditory and visual systems. In 1927, Alport1 was the first to recognize a link between progressive nephropathy and hearing disability. Although anterior lenticonus was observed as early as 1891,2 Jaworski3 was the first to describe the association of anterior lenticonus and nephropathies in 1910. In 1966, Arnott et al4 reported anterior lenticonus as a specific sign of Alport syndrome. Several mutations affecting the α-5-chain of type IV collagen, which is predominantly present in basement membranes, are associated with the complex disease.5 Atkin et al6 distinguished 7 phenotypes, differing in type of inheritance (autosomal dominant, recessive, or X-linked), age of onset of renal insufficiency, and additional complications such as anterior lenticonus and thrombocytopenia. According to Atkin and colleagues, Alport syndrome types I, II, and VI, also known as the Sohar phenotype, present the triad of nephropathy either with juvenile-onset gross hematuria or essential microhematuria, both of which eventually lead to renal insufficiency, progressive high-tone sensorineural deafness, and ocular anomalies. The ocular changes most frequently affect the lens in the form of anterior lenticonus, posterior subcapsular cataract, and spherophakia. Retinal involvement is seen as albinopunctatus fundi. The 3 types of Alport syndrome differ in age of onset of renal insufficiency (before or after age 30 years) and type of inheritance. In 1978, Nielsen7 reviewed all reported cases of anterior lenticonus and found that it is exclusively described in patients with Alport syndrome. Typically, diagnosis of Alport syndrome is based on electron microscopic changes in the glomerular basement membranes of biopsy specimens.

REPORT OF A CASE

CLINICAL FINDINGS

A 38-year-old man was seen for progressively decreasing visual acuity during recent years. He reported normal visual acuity in childhood. Findings from eye
examinations obtained at age 18 years did not reveal a need for glasses when driving. Since age 24 years, he wore glasses with increasing corrective power. His family history was negative for any kind of ophthalmological diseases. His visual acuity at initial examination was 20/400 OD, counting fingers OS; best-corrected visual acuity was 20/60 OD and 20/50 OS. Retinal acuity was determined at 20/40 OD and 20/30 OS.

Findings from slitlamp examination revealed bilateral anterior lenticonus and distinct central posterior subcapsular lens opacities. The lens findings were documented using a modified Scheimpflug imaging system (Topcon SL-45; Topcon Corp, Tokyo, Japan) (Figure 1). Except for the described lens, ophthalmologic findings were within normal limits.

On detailed questioning, the patient revealed a history of persistent microhematuria and proteinuria since childhood. He had been admitted to the hospital several times owing to renal colic since age 20 years. The cause of the renal disease was unknown to the patient. A renal biopsy had never been requested. He also had progressive high-frequency deafness. To correct his hearing disability, he was scheduled to receive prosthetic transplants. His family history, including his parents, 3 brothers and sisters, and 2 children, was negative for renal disease and deafness. He declined genetic diagnostic testing for himself and his children.

The patient felt restricted in his daily life by poor visual performance, and for visual rehabilitation, an extracapsular cataract extraction was performed. During the capsulorhexis, a remarkably thin and fragile anterior capsule was recovered for electron microscopy. The patient’s postsurgical course was unremarkable. He achieved a corrected visual acuity of 20/30 OU.

TRANSMISSION ELECTRON MICROSCOPY

The capsulorhexis fragment recovered during cataract surgery was fixed in 2.5% glutaraldehyde and processed in epoxy resin for transmission electron microscopy. Capsule thickness varied from 5 µm to 12 µm (reference range, 16-18 µm) with the thinnest diameter in the center and the thickest at the periphery of the specimen. The central parts of the capsule showed multiple striking dis-
ruptions extending through the whole thickness of the capsule and at times joining other such disruptions. In the thinnest areas, the disruptions were 3 µm to 10 µm apart. Their width varied from 0.25 µm to 1.50 µm. In the thicker peripheral parts of the capsule, these disruptions were less frequent and smaller (Figure 2, top). Most of the disruptions were filled with low-density materials. Filamentous connective bridges spanning the disruptions and vacuolar spaces with adjacent dense osmiophilic spheres were seen with a higher magnification (Figure 2, bottom).

COMMENT

Our patient had typical signs of Alport syndrome type VI (Sohar phenotype). More than 90% of the currently described patients with anterior lenticonus had Alport syndrome. In the case of this rare ophthalmological diagnosis, Alport syndrome should always be suspected. The thinness of the capsule and the disruptions shown in transmission electron microscopy explain the observed fragility during capsulorhexis and anecdotally reported spontaneous capsule ruptures in the natural course of anterior lenticonus.

Though less severe, our ultrastructural findings are consistent with those described by Streeten et al, who examined lens capsules of patients with Alport syndrome confirmed by findings from renal biopsy. The difference in the degree of severity may reflect different stages of the progressive disease. The consistency of findings, however, strongly supports our hypothesis that ultrastructural analysis of the lens capsule may also serve to prove the diagnosis of Alport syndrome. Thus, it may replace the necessity of conducting a renal biopsy in some patients. To date, the diagnosis of Alport syndrome requires the presence of at least 3 of 4 clues: family history positive for Alport syndrome, progressive intraauricular deafness, characteristic eye anomalies, and ultrastructural proof of glomerular changes. We believe that ultrastructural changes of the lens capsule can be considered as an alternative diagnostic criterion to glomerular basement changes.

Accepted for publication January 5, 2000.

We would like to thank Elisabeth Messmer, MD, for her valuable advice in the preparation of the transmission electron microscopic figures.

Corresponding author: Anna K. Junk, MD, Department of Ophthalmology, Columbia University, Eye Radiation and Environmental Research Laboratory (ERERL), Room 211, 630 W 168th St, New York, NY 10032 (e-mail: akj19@columbia.edu).

REFERENCES

etters would have been beneficial. In our experience, patients receiving secondary implants have the most severe pain, probably owing to more extraocular muscle manipulation and orbital dissection. We have not found this to be as much of a problem with evisceration, possibility due to our technique. During evisceration, we remove a posterior scleral button containing the optic nerve and posterior ciliary nerves. This scleral button is cleaned of any uveal tissue and then placed anteriorly to the orbital implant. This serves 2 purposes: (1) to remove the sensory nerves to the eye and (2) to act as a reinforcing graft anteriorly.

Several things have also changed since the article was written, primarily that we now soak our orbital implants in bupivacaine hydrochloride solution prior to implantation. This has decreased the need for orbital catheters in patients undergoing enucleation and evisceration. We primarily use orbital catheters now when performing secondary orbital implants.

If Dr Jordan has had good success in controlling pain without using a catheter, similar to our success rate with using a catheter, perhaps in his situation the use of a catheter is not warranted.

John Fezza, MD
Venice, Fla
Ralph E. Wesley, MD
Kim A. Klippenstein, MD
Nashville, Tenn

Laser Misuse, Legal Problems—Yes

Dr Mainster states that laser pointers are not toys; I agree. I believe, as well as others in law enforcement, safety, and emergency medical services, that there should be legislation passed yielding a legal consequence when lasers are used in an aggressive assault. Several groups are actively obtaining information on laser assaults to get more states to pass legislation. Not as an ophthalmologist, but as a reserve deputy sheriff and helicopter pilot for the sheriff's department, I have experienced the anxiety of a laser pointer being directed at the helicopter. A primary worry is whether there is a weapon with the laser that can take the aircraft, fire truck, or emergency medical services vehicle out of action. When evasive action leads to a crash with fatalities, eye damage becomes a mute point.

The more powerful and expensive lasers are becoming less expensive and more portable. “Six-packs,” 6 of the small lasers taped together, focused at a driver’s eyes can cause accidents and tremendous canopy glare. A grocery store laser scanner (helium-neon laser, 10 watts at 632.8 nm, a class 3B laser), power enhanced, was made portable, powered by a car battery, and was directed at a California police helicopter, leading to the arrest of the perpetrator. A military laser used from a Russian freighter off Washington State on April 4, 1997, targeting a helicopter caused retinal problems, ending the career of the Canadian Armed Forces helicopter pilot and the American naval observer who were on patrol with the Trident Submarine, USS Ohio.

Willing participation? Blink reflex protection? Not when a person has an aggressive 6-pack assault on their eyes.

Ronald W. Case, MD, Aviation Medical Examiner
Lakeland, Fla