Childhood Glaucoma Associated With Developmental Ocular and Systemic Disorders

Preventing blindness requires recognizing the abnormalities associated with this group of diseases.

BY DAVID S. WALTON, MD

Childhood glaucoma is an important and demanding cause of preventable childhood blindness. Some pediatricians and other childcare workers' unfamiliarity with the diagnostic signs of glaucoma in children can delay its recognition. In addition, parents often do not recognize the significance of the early abnormalities secondary to increased IOP such as ocular enlargement and photophobia. Childhood glaucoma also challenges eye care specialists. Its rarity means that the necessary examination techniques are practiced infrequently. Moreover, they require special instrumentation, are time consuming, and are not easily handed off to office assistants.

Upon diagnosis, the type and severity of the eye disease must be determined, and the potential for associated pediatric systemic conditions must be actively considered. Medical therapy is often less successful than in adults, and the execution of appropriate glaucoma surgical procedures in infants and young children may initially be uncomfortable even for experienced eye surgeons. Parents are typically surprised by the diagnosis of childhood glaucoma and may become overwhelmed by the logistical challenge of care as well as by their feelings of responsibility for both the condition and its delayed recognition. That said, parents are amazingly resilient, and their subsequent positive efforts to support physicians are both humbling and essential to the successful treatment of these glaucomas.

To achieve the best possible outcomes, the ophthalmologist must become familiar with the many potential types of pediatric glaucoma (see *The Childhood Glaucomas*)[1] and their medical or surgical treatments. In addition, he or she must have instrumentation available for tonometry, inspection of the anterior segment, and gonioscopy.

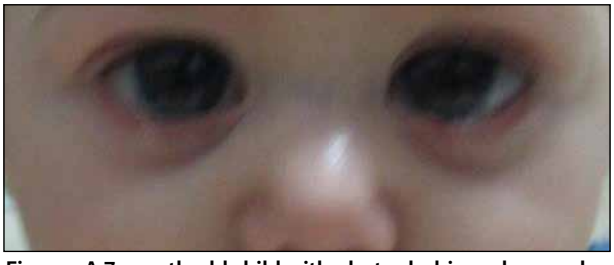

Figure. A 7-month-old child with photophobia and corneal enlargement secondary to raised IOP associated with infantile PCG.

DIAGNOSIS

The most common primary childhood glaucoma is primary congenital glaucoma (PCG).[2] This hereditary glaucoma can be caused by 147 mutations to one gene, *CYP1B1*.[3] This gene has been mapped to chromosome 2p22.2 and may be responsible for approximately one-third of the cases of PCG. The incidence of this disease ranges from 1:2,500 to 1:60,000 and is highly variable in different geographic and ethnic populations.[4]

PCG may present at birth associated with prompt recognition of corneal anomalies and opacities secondary to increased IOP.[5] More frequently, however, PCG is detected during the first year of life when a primary care physician or parent notices a child's symptomatic photophobia and corneal enlargement and opacification (Figure). When the disease is less severe, however, these anterior segment abnormalities may be less obvious, leading to the late recognition of PCG. In these cases, PCG is diagnosed by the presence of decreased visual acuity, corneal enlargement, and, rarely, routine tonometry.

THE CHILDHOOD GLAUCOMAS

I. Primary Developmental Glaucomas
- A. Primary congenital glaucoma
  1. Newborn
  2. Infantile
  3. Late recognized
- B. Juvenile open-angle glaucoma
- C. Primary glaucomas associated with systemic diseases
  1. Sturge-Weber syndrome
  2. Neurofibromatosis (NF-1)
  3. Stickler syndrome
  4. Oculocerebrorenal syndrome (Lowe)
  5. Axenfeld-Rieger syndrome
  6. SHORT syndrome
  7. Hepatocerebrorenal syndrome (Zellweger)
  8. Marfan syndrome
  9. Rubinstein-Taybi syndrome
  10. Infantile glaucoma with retardation and paralysis
  11. Oculodentodigital dysplasia
  12. Glaucoma with microcornea and absent sinuses
  13. Mucopolysaccharidosis
  14. Trisomy 13
  15. Caudal regression syndrome
  16. Trisomy 21 (Down syndrome)
  17. Cutis marmorata telangiectatica congenita
  18. Warburg syndrome
  19. Kniest syndrome (skeletal dysplasia)
  20. Michel's syndrome
  21. Nonprogressive hemiatrophy
  22. PHACES syndrome
  23. Soto syndrome
  24. Linear scleroderma
  25. GAPO syndrome
  26. Roberts pseudothalidomide syndrome
  27. Wolf-Hirschhorn (4p-) syndrome
  28. Robinow syndrome
  29. Nail-patella syndrome
  30. Proteus syndrome
  31. Fetal hydantoin syndrome
  32. Cranio-cerebello-cardiac (3C) syndrome
  33. Brachmann-deLange syndrome
  34. Rothmund-Thomson syndrome
  35. 9p deletion syndrome
  36. Phakomatosis pigmentovascularis
  37. Jacobsen syndrome
- D. Primary glaucomas associated with ocular anomalies
  1. Aniridia
     a. Congenital aniridic glaucoma
     b. Acquired aniridic glaucoma
  2. Congenital ocular melanosis
  3. Sclerocornea
  4. Congenital iris ectropion syndrome
  5. Peters syndrome
  6. Iridotrabecular dysgenesis (iris hypoplasia)
  7. Posterior polymorphous dystrophy
  8. Idiopathic or familial elevated venous pressure
  9. Congenital anterior (corneal) staphyloma
  10. Congenital microcoria
  11. Congenital hereditary endothelial dystrophy
  12. Axenfeld-Rieger anomaly

II. Secondary (Acquired) Glaucomas
- A. Traumatic glaucoma
  1. Acute glaucoma
     a. Angle concussion
     b. Hyphema
     c. Ghost cell glaucoma
  2. Glaucoma related to angle recession
  3. Arteriovenous fistula
- B. Glaucoma with intraocular neoplasms
  1. Retinoblastoma
  2. Juvenile xanthogranuloma
  3. Leukemia
  4. Melanoma of ciliary body
  5. Melanocytoma
  6. Iris rhabdomyosarcoma
  7. Aggressive iris nevi
  8. Medulloepithelioma
  9. Mucogenic glaucoma with iris stromal cyst
- C. Glaucoma related to chronic uveitis
  1. Open-angle glaucoma
  2. Angle-blockage mechanisms
     a. Synechial angle closure
     b. Iris bombé with pupillary block
     c. Trabecular endothelialization
- D. Lens-related glaucoma
  1. Subluxation-dislocation with pupillary block
     a. Marfan syndrome
     b. Homocystinuria
     c. Weill-Marchesani syndrome
     d. Axial subluxation high myopia syndrome
     e. Ectopia lentis et pupillae

THE CHILDHOOD GLAUCOMAS (CONTINUED)

2. Spherophakia with pupillary block
3. Phacolytic glaucoma

E. Glaucoma after lensectomy for congenital cataracts
1. Pupillary-block glaucoma
2. Infantile aphakic open-angle glaucoma

F. Glaucoma secondary to corticosteroids

G. Glaucoma secondary to rubeosis
1. Retinoblastoma
2. Coats disease
3. Medulloepithelioma
4. Familial exudative vitreoretinopathy
5. Chronic retinal detachment

H. Angle-closure glaucoma
1. Cicatrical retinopathy of prematurity
2. Microphthalmos
3. Nanophthalmos
4. Retinoblastoma
5. Persistent hyperplastic primary vitreous
6. Congenital pupillary iris-lens membrane
7. Topiramate therapy
8. Central retinal vein occlusion
9. Ciliary body cysts
10. After laser therapy for threshold retinopathy of prematurity

I. Malignant glaucoma

J. Glaucoma associated with increased venous pressure
1. Cavernous or dural sinus arteriovenous shunt
2. Orbital disease
3. Sturge-Weber syndrome

K. Intraocular infection
1. Acute recurrent toxoplasmosis
2. Acute herpetic iritis
3. Maternal rubella infection
4. After endogenous endophthalmitis

L. Glaucoma secondary to unknown etiology
1. Iridocorneal endothelial syndrome

M. Acute ischemic secondary glaucoma
1. Related to viscoelastics
2. Related to hyphema
3. Related to acute pupillary block

During the ocular examination, gonioscopy is most helpful to distinguish PCG from other types of pediatric glaucoma. Typically, the filtration angle anomaly is confined to the relative presence of the trabecular meshwork, scleral spur, and ciliary body regions.

TREATMENT

PCG patients often require glaucoma surgery. Goniosurgery is the first line, unless an advanced angle anomaly is present, as may be seen with the newborn expression of this condition.[5-7]

The success of goniosurgery for PCG relates to the severity of the filtration angle defect.[8] When patients present at birth with cloudy corneas, elevated IOP, and iris anomalies, the disease may be complicated by filtration angle hypoplasia. Gonioscopy may be difficult in these children, and the surgeon must consider the placement of a glaucoma drainage device instead of initial goniosurgery.[5] Patients with PCG recognized after 1 month of age with corneal signs secondary to the elevated IOP can be expected to do well with goniosurgery, even when the diagnosis is made later in childhood. When goniosurgery fails after 6 months of age, trabeculectomy or glaucoma drainage implants must be used.[9]

CONCLUSION

Pediatric glaucoma is unusual but an important cause of childhood blindness. Signs of the disease early in life and during eye examinations throughout childhood offer the opportunity for glaucoma's recognition and prompt treatment. Both the medical and the surgical treatment of childhood glaucoma have advanced in the past 25 years related to the increased interest and improved training of pediatric and glaucoma specialists. Once a hopeless diagnosis, parents now bring their children for glaucoma care with an expectation of successful treatment. ■

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