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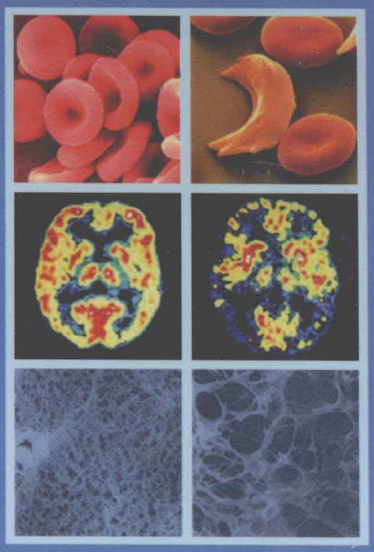

ANESTHESIA and UNCOMMON DISEASES

5th edition

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ANESTHESIA and UNCOMMON DISEASES

5th Edition

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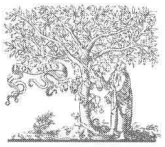

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ANESTHESIA AND UNCOMMON DISEASES
ISBN-13: 978-1-4160-2212-1
ISBN-10: 1-4160-2212-0

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The Publisher

Library of Congress Cataloging-in-Publication Data
Anesthesia and uncommon diseases. – 5th ed. / editor, Lee A. Fleisher.
p. ; cm.
Rev. ed. of: Anesthesia & uncommon diseases / [edited by] Jonathan L. Benumof. 4th ed. c1998.
ISBN 1-4160-2212-0
1. Anesthesia—Complications. 2. Rare diseases—Surgery—Complications. 3. Rare diseases —Pathophysiology. I. Fleisher, Lee A. II. Anesthesia & uncommon diseases.
[DNLM: 1. Anesthesia. 2. Disease. WO 235 A5791 2006]
RD87.A54 2006
617.9′6—dc22

2005047247

Publisher: Natasha Andjelkovic
Developmental Editor: Agnes Byrne
Marketing Manager: Emily M. Christie
Publishing Services Manager: Tina Rebane
Project Manager: Norm Stellander
Design Direction: Steve Stave

Printed in the United States of America

Last digit is the print number: 9 8 7 6 5 4 3 2 1

This book is dedicated to

My wife, Renee, who is my true partner in life, an outstanding example to our children, and a sounding board.

Two very important teachers from my residency at Yale University, Paul G. Barash and Stanley Rosenbaum. Paul, who was my first Chair, provided me with the encouragement, support, and resources to pursue my interest in the evaluation of the patient with cardiovascular disease undergoing noncardiac surgery. Stanley, who was one of my first attendings, taught me the art and science of caring for patients with complex medical comorbidities and became an important collaborator in my early research efforts. Both of these individuals have remained mentors and became close friends, and their insights have helped me achieve my own goals.

LEE A. FLEISHER

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Foreword

What are uncommon diseases? The *Oxford English Dictionary* defines "uncommon" as not possessed in common, not commonly (to be) met with, not of ordinary occurrence, unusual, rare. "Rare" has various meanings, such as few in number and widely separated from each other (in space or time), though also including unusual and exceptional. Another synonym for uncommon is "infrequent," the definition of which includes not occurring often, happening rarely, recurring at wide intervals of time. The chapter entitled Respiratory Diseases in this edition aims to review "less common" pulmonary conditions, rather than "uncommon." None of these definitions include quantification.

Why do we need a separate text to help us conduct the anesthetics of illnesses that do not happen often, if that is indeed the case? The simplest answer, congruent with the present obsession with the wisdom of the market, might be that the need has been already proven by the fact that the anesthetic community has bought sufficient copies of the previous four editions of this book to warrant a fifth. Nevertheless, it seems an intriguing question. Are the readers of the book residents studying arcane facts in order to pass certification examinations? Are they investigators searching for relevant questions to research? Are they isolated clinicians faced with the necessity of managing patients with unusual conditions they encounter so infrequently that they do not recall (or never knew) the most relevant facts requisite for providing safe care? Do the many uncommon conditions, even though each might occur infrequently, happen sufficiently often in the aggregate that we would ignore them to the peril of our patients?

To begin to approach this question, we need to consider the practice of medicine and the fact that medicine is a profession. Professions are occupations in which groups of individuals are granted a monopoly by society to learn and apply advanced knowledge in some area for the benefit of that society. The profession has the obligation to transmit that knowledge to others who will join that profession, to develop new knowledge and to maintain standards of practice by self-regulation. There is a moral covenant with society to behave altruistically, that is, for the professional to subsume her or his own personal interests for the benefit of the society. These characteristics translate into an obligation to provide competent care for all who entrust themselves into our hands, no matter how rare or esoteric their condition may be. In the practice of anesthesiology (and of all of medicine, for that matter), it is not possible for any one individual to know everything necessary to fulfill that responsibility. Thus, we are dependent on rapid access to gain sufficient knowledge to approach that duty.

In the preface to the first edition of *Anesthesia and Uncommon Diseases* (1973), editors Jordan Katz and Leslie B. Kadis stressed their intention to present disease entities whose underlying pathophysiologic processes might profoundly affect normal anesthetic management. They noted that, "In general, the information we wanted to present has never been published." This resulted in "a compendium of what is *and is not* known about unusual diseases as they may or may not relate to anesthesia." The authors expressed the hope that their work would stimulate others to publish their experiences.

The subsequent three decades have seen a remarkable growth and development of knowledge in biomedical science, including anesthesiology and its related disciplines. Many others have indeed published their experiences with conditions covered in editions of this book. This has resulted in understanding the physiology and safe anesthetic management of many of these diseases, so that recommendations for their management can be provided with confidence. It has also been accompanied by recognition of other, not previously recognized, illnesses that have joined the ranks of "uncommon diseases." An example of the former is the present virtually complete understanding of succinylcholine-associated hyperkalemia in certain muscle diseases; an example of the latter is the entire field of mitochondrial diseases, which is the topic of a completely new chapter in this edition.

Anesthesiology has been characterized as hours of boredom interspersed with moments of terror. I would argue strongly that this is an incomplete and misleading characterization, but will not expand on that here. However, as a recovering clinician who spent decades (unsuccessfully) attempting to make every anesthetic as "boring" as possible, I can vouch that terror is indeed an inevitable

component of the specialty. Knowledge—technical, experiential, judgmental, didactic—is the most effective deterrent to these vexing episodes, and the best tool to successfully confront them when they occur. This book is a single source of extremely useful and provocative knowledge, for trainees, practitioners and investigators alike. I suspect this is why the previous editions of this book have been so successful, why this updated and much changed edition, with a new editor, new topics, and new contributors, will also be a success, and why we will need further new editions in future.

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Preface

It was a pleasure to edit the fifth edition of *Anesthesia and Uncommon Diseases,* following the traditions of Dr. Benumof in the fourth edition, and Drs. Katz, Benumof, and Kadis from previous editions. As a resident at Yale New Haven Hospital, the third edition of this book was always an important component of my planning for the next day's anesthetic. Therefore, it was a great honor to be asked to edit this latest edition. In order to both do justice to the previous editions and take this text into the 21st century, the fifth edition of *Anesthesia and Uncommon Diseases* has been revised and restructured. The overall look and feel is different, with a new outline structure and tables. New authors have been invited to offer a new perspective and provide the reader with the latest information. Finally, additional chapters have been included to focus on more recently defined unique disease entities, such as those associated with mitochondrial dysfunction. I am very grateful that an outstanding group of authors agreed to participate in this new edition.

In putting together a multi-author text, numerous people must be acknowledged. I would like to thank my editorial assistant, Kate Musselman, for her outstanding editorial work on the chapters, as well as for managing a diverse group of authors. I would also like to thank Natasha Andjelkovic, my publisher at Elsevier, for her patience and support, and Agnes Byrne, our developmental editor, whose guidance was very valuable.

LEE A. FLEISHER, MD
Editor

Contents

CHAPTER

1 Eye, Ear, Nose, and Throat Diseases

KATHRYN E. MCGOLDRICK, MD

Many patients presenting for relatively "simple" ophthalmic or otorhinolaryngologic procedures suffer from complex systemic diseases. Although the surgeon may have the luxury of being able to focus on one specific aspect of the patient's condition, the anesthesiologist must be knowledgeable about the ramifications of the entire disease complex and the germane implications for anesthetic management. Issues of safety often are complicated by the logistic necessity for the anesthesiologist to be positioned at a considerable distance from the patient's face, thus preventing immediate access to the airway for certain types of ophthalmic surgery. Additionally, during many laryngologic surgeries the anesthesiologist must share the airway with the surgeon. Moreover, many of these complicated patients undergo surgical procedures that are routinely performed on an ambulatory basis, thereby further challenging the anesthesiologist to provide a rapid, smooth, problem-free recovery.

The focus of this chapter is on several eye as well as ear, nose, and throat (ENT) conditions, many of which are relatively rare. Nonetheless, it behooves the anesthesiologist to understand the complexities involved because failure to do so may be associated with preventable morbidity and mortality.

EYE DISEASES: GENERAL CONSIDERATIONS

Patients with eye conditions are often at the extremes of age, ranging from tiny, fragile infants with retinopathy of prematurity or congenital cataracts to nonagenarians with submacular hemorrhage, and may have extensive associated systemic processes or metabolic diseases.[1] Moreover, the increased longevity characteristic of developed nations has produced a concomitant increase in the longitudinal prevalence of major eye diseases. A study of elderly Medicare beneficiaries followed for 9 years during the 1990s documented a dramatic increase in the prevalence of major chronic eye diseases associated with aging.[2] For example, the prevalence of diabetes mellitus increased from 14.5% at baseline in the study patients to 25.6% nine years later, with diabetic retinopathy among persons with diabetes mellitus increasing from 6.9% to 17.4% of the subset. Primary open-angle glaucoma increased from 4.6% to 13.8%, and the percentage of glaucoma suspects increased from 1.5% to 6.5%. The prevalence of age-related macular degeneration increased from 5.0% to 27.1%. Overall, the proportion of subjects with at least one of these three chronic eye diseases increased impressively from 13.4% to 45.4% of the elderly Medicare population.

Ophthalmic conditions typically involve either the cornea, the lens, the vitreoretinal area, the intraocular pressure–regulating apparatus, or the eye muscles and adnexa. These patients may present for corneal transplantation, cataract extraction, vitrectomy for vitreous hemorrhage, scleral buckling for retinal detachment, trabeculectomy and other glaucoma filtration procedures for glaucoma amelioration, or rectus muscle recession and resection for strabismus, respectively. Conversely, they may require surgery for a condition entirely unrelated to their ocular pathology; nonetheless, their ocular disease per se may present issues for anesthetic management, or the eye pathology may be but one manifestation of a constellation of systemic conditions that constitute a syndrome with major anesthetic implications (Table 1-1).

Other, less common eye defects frequently linked with coexisting diseases include aniridia, colobomas, and optic nerve hypoplasia. *Aniridia,* a developmental abnormality characterized by striking hypoplasia of the iris, is a misnomer, because the iris is not totally absent. The term describes just one facet of a complex developmental disorder that features macular and optic nerve hypoplasia as well as associated cataracts, glaucoma, ectopia lentis, progressive opacification, and nystagmus. At least two types of aniridia have been described. Type I is transmitted in an autosomal dominant fashion; the involved gene is thought to be on chromosome 2. Aniridia type II usually appears sporadically and is associated with an interstitial deletion on the short arm of chromosome 11 (11p13), although rarely a balanced translocation of chromosome 11 may produce familial type II aniridia. In addition to the typical ocular lesions, children with type II aniridia frequently are mentally retarded and have genitourinary anomalies—the ARG triad. Individuals with the chromosome 11 defect and this triad may develop Wilms' tumor[3] and should be followed with regular abdominal examinations and frequent renal ultrasonography at least until they are 4 years old. Chromosomal analysis is indicated in all infants with congenital aniridia.

Coloboma denotes an absence or defect of some ocular tissue, usually resulting from malclosure of the fetal intraocular fissure, or rarely from trauma or disease. Two major types of ocular colobomas are chorioretinal or fundus coloboma and isolated optic nerve coloboma. The typical fundus coloboma is caused by malclosure of the embryonic fissure, resulting in a gap in the retina, retinal pigment epithelium, and choroid. These defects may be unilateral or bilateral and usually produce a visual field defect corresponding to the chorioretinal defect. Although colobomas may occur independent of other abnormalities, they also may be associated with microphthalmos, cyclopia, anencephaly, or other major central nervous system aberrations. They frequently are linked with chromosomal abnormalities, especially the trisomy 13 and 18 syndromes. Colobomas may be seen with the CHARGE (congenital heart disease, choanal atresia, mental retardation, genital hypoplasia, and ear anomalies) syndrome or the VATER (tracheoesophageal fistula, congenital heart disease, and renal anomalies) association. Rarely, isolated colobomas of the optic nerve occur. They may be familial and may be associated with other ocular pathology, as well as with systemic defects including cardiac conditions.

Optic nerve hypoplasia is a developmental defect characterized by deficiency of optic nerve fibers. The anomaly may be unilateral or bilateral, be mild to severe, and be associated with a broad spectrum of ophthalmoscopic findings and clinical manifestations. Visual impairment may range from minimal reduction in acuity[4] to blindness. Strabismus or nystagmus secondary to visual impairment is common. Although optic nerve hypoplasia may occur as an isolated defect in otherwise normal children, the lesion can be associated with aniridia, microphthalmos, coloboma, anencephaly, hydrocephalus, hydranencephaly, and encephalocele. Optic nerve hypoplasia may occur in a syndrome termed *septo-optic dysplasia* or de Morsier's syndrome. There may be coexisting hypothalamic conditions and extremely variable endocrine aberrations.[5,6] An isolated deficiency of growth hormone is most common, but multiple hormonal imbalances, including diabetes insipidus, have been reported. The etiology of optic nerve hypoplasia remains unknown. However, it has been observed to occur with slightly increased frequency in infants of diabetic mothers,[4] and the prenatal use of drugs such as LSD (lysergic acid diethylamide), meperidine, phenytoin, and quinine has been implicated sporadically.

TABLE 1–1 Ophthalmic Conditions Frequently Associated with Coexisting Diseases

Aniridia	Macular hypoplasia
Cataracts	Nystagmus
Colobomata	Optic nerve hypoplasia
Corneal dystrophies	Retinal detachment
Ectopia lentis	Retinopathy
Glaucoma	Strabismus

Corneal Pathology and Systemic Disease

A vast spectrum of conditions may be associated with corneal pathology (Table 1-2). Such diverse entities as inflammatory diseases, connective tissue disorders, metabolic diseases, and even skin conditions have been reported in conjunction with corneal abnormalities.[7]

Examples of inflammatory diseases associated with corneal pathology include rheumatoid arthritis, Reiter's syndrome, Behçet's syndrome, and sarcoidosis.

Connective tissues disorders such as ankylosing spondylosis, scleroderma, Sjögren's syndrome, and Wegener's

TABLE 1–2 Examples of Systemic Diseases Associated with Corneal Pathology

Connective Tissue Disorders
Ankylosing spondylosis
Scleroderma
Sjögren's syndrome
Wegener's granulomatosis
Inflammatory Diseases
Behçet's syndrome
Reiter's syndrome
Rheumatoid arthritis
Sarcoidosis
Metabolic Diseases
Carbohydrate metabolism disorders
Chronic renal failure
Cystinosis
Gout
Graves' disease
Wilson's disease
Skin Disorders
Erythema multiforme
Pemphigus

granulomatosis have been associated with corneal disturbances.

Metabolic diseases, including cystinosis, disorders of carbohydrate metabolism, gout, hyperlipidemia, and Wilson's disease, have also been linked with corneal pathology. Additionally, such conditions as Graves' hyperthyroid disease, leprosy, chronic renal failure, and tuberculosis may have associated corneal disease. Even skin diseases such as erythema multiforme and pemphigus have corneal manifestations. Finally, mandibulo-oculofacial dyscephaly (Hallermann-Streiff syndrome) is of interest to anesthesiologists because of anticipated difficulty with intubation.

Lens Pathology and Systemic Disease

A cataract is defined as a clouding of the normally clear crystalline lens of the eye. The different types of cataracts include nuclear-sclerotic, cortical, posterior subcapsular, and mixed. Each type has its own location in the lens and risk factors for development, with nuclear-sclerotic cataracts being the most common type of age-related cataract. The leading cause of blindness worldwide, cataracts affect more than 6 million individuals annually.[8] Indeed, cataract surgery is the most frequently performed surgical procedure in the United States with more than 1.5 million operations annually.[9] Over half the population older than age 65 years develop age-related cataracts with related visual disability.[10] Yet, despite extensive research into the pathogenesis and pharmacologic prevention of cataracts, there are no proven means to prevent age-related cataracts.

Although age-related cataracts are the most frequently encountered variety, cataracts may be associated with dermatologic diseases such as incontinentia pigmenti, exogenous substances, genetic diseases, hematologic diseases, infections, and metabolic perturbations (Table 1-3).

TABLE 1–3 Conditions Associated with Cataracts

Aging
Chromosomal Anomalies
Trisomy 13
Trisomy 18
Trisomy 21
Turner's syndrome
Dermatologic Diseases
Incontinentia pigmenti
Exogenous Substances
Alcohol
Ergot
Naphthalene
Parachlorobenzene
Phenothiazines
Metabolic Conditions
Diabetes mellitus
Fabry's disease
Galactosemia
Hypoparathyroidism
Hypothyroidism
Lowe's syndrome
Phenylketonuria
Refsum's disease
Wilson's disease
Xanthomatosis
Infectious Diseases
Herpes
Influenza
Mumps
Polio
Rubella
Toxoplasmosis
Vaccinia
Varicella zoster

Exogenous substances that can trigger cataracts include corticosteroids,[11-13] phenothiazines, naphthalene, ergot, parachlorobenzene, and alcohol.[14] Metabolic conditions associated with cataracts include diabetes mellitus, Fabry's disease, galactosemia, hepatolenticular degeneration (Wilson's disease), hypoparathyroidism, hypothyroidism, phenylketonuria, Refsum's disease, and xanthomatosis. Another metabolic disorder important in the differential diagnosis of congenital cataracts is Lowe's (oculocerebrorenal) syndrome. In this X-linked disorder, cataract is frequently the presenting sign, with other abnormalities appearing later. These anomalies include mental and growth retardation, hypotonia, renal acidosis, aminoaciduria, proteinuria, and renal rickets, requiring calcium and vitamin D therapy.[15,16] Other concomitants include osteoporosis and a distinctive facies (long with frontal bossing). Although lens changes may be seen frequently in heterozygous female children also, affected male children commonly have obvious, dense, bilateral cataracts at birth. They may also be afflicted with associated glaucoma. Interestingly, carrier females in their second decade of life have significantly higher numbers of lens opacities than age-related controls; however, absence of opacities is no guarantee that an individual is not a carrier. Anesthetic management includes careful attention to acid-base balance and to serum levels of calcium and electrolytes. The administration of drugs excreted by the kidney should be observed carefully, and nephrotoxins should be avoided. The patient with osteoporosis should be positioned on the operating table with extreme gentleness.

Infectious causes of cataracts include herpes, influenza, mumps, polio, rubella, toxoplasmosis, vaccinia, and varicella zoster.[17] Chromosomal anomalies associated with cataracts include trisomy 13 (Patau's syndrome), trisomy 18 (Edward's syndrome), and trisomy 21 (Down syndrome). In Patau's and Edward's syndromes, congenital cataracts frequently occur in conjunction with other ocular anomalies, such as coloboma and microphthalmia. Cataracts have also been reported with Turner's syndrome (XO).

An additional type of lens abnormality that can be associated with major systemic disease is *ectopia lentis* (Table 1-4). Displacement of the lens can be classified topographically as subluxation or luxation. Luxation denotes a lens that is dislocated either posteriorly into the vitreous cavity or, less commonly, anteriorly into the anterior chamber. In subluxation, some zonular attachments remain and the lens remains in its plane posterior to the iris, albeit tilted in one direction or another.

The most common cause of lens displacement is trauma, although ectopia lentis may also result from assorted other ocular diseases, such as intraocular tumor, congenital glaucoma, uveitis, aniridia, syphilis, or high myopia. Inherited defects and serious systemic diseases, such as Marfan's syndrome, homocystinuria, Weill-Marchesani syndrome, hyperlysinemia, and sulfite oxidase deficiency, are also associated with ectopia lentis. Indeed, lens displacement occurs in approximately 80% of patients with Marfan's syndrome.

TABLE 1–4 Conditions Associated with Ectopia Lentis

Ocular Conditions
Aniridia
Congenital glaucoma
High myopia
Intraocular tumor
Trauma
Uveitis
Systemic Diseases
Homocystinuria
Hyperlysinemia
Marfan's syndrome
Sulfite oxidase deficiency
Weill-Marchesani syndrome

Glaucoma and Systemic Disease

Glaucoma is a condition characterized by elevated intraocular pressure (IOP), resulting in impairment of capillary blood flow to the optic nerve and eventual loss of optic nerve tissue and function. Two different anatomic types of glaucoma exist: open-angle or chronic simple glaucoma and closed-angle or acute glaucoma. (Other variations of these processes occur but are not especially germane to anesthetic management. Glaucoma is, in fact, not one disease, but many.)

With open-angle glaucoma, the elevated IOP exists in conjunction with an anatomically patent anterior chamber angle. It is thought that sclerosis of trabecular tissue produces impaired aqueous filtration and drainage. Treatment consists of medication to produce miosis and trabecular stretching. Commonly used eyedrops include epinephrine, echothiophate iodide, timolol, dipivefrin, and betaxolol. Carbonic anhydrase inhibitors such as acetazolamide can also be administered by various routes to reduce IOP by interfering with the production of aqueous humor. All these drugs are systemically absorbed and can, therefore, have anticipated side effects.

It is important to appreciate that maintenance of IOP is determined primarily by the rate of aqueous formation and the rate of aqueous outflow. The most important influence on formation of aqueous humor is the difference in osmotic pressure between aqueous and plasma. This concept is illustrated by the equation:

$$IOP = K[(OPaq - OPpl) + CP]$$

where K = coefficient of outflow, OPaq = osmotic pressure of aqueous humor, OPpl = osmotic pressure of plasma, and CP = capillary pressure. The fact that a small change in solute concentration of plasma can dramatically affect the formation of aqueous humor and hence IOP is the rationale for administering hypertonic solutions, such as mannitol, to reduce IOP.

Fluctuations in aqueous outflow can also markedly change IOP. The primary factor controlling aqueous humor outflow is the diameter of Fontana's spaces, as illustrated by the equation:

$$A = [r^4 \times (Piop - Pv)] \div 8\eta L$$

where A = volume of aqueous outflow per unit of time, r = radius of Fontana's spaces, Piop = IOP, Pv = venous pressure, η = viscosity, and L = length of Fontana's spaces. When the pupil dilates, Fontana's spaces narrow, resistance to outflow is increased, and IOP rises. Because mydriasis is undesirable in both closed- and open-angle glaucoma, miotics such as pilocarpine are applied conjunctivally in patients with glaucoma.

The aforementioned equation describing the volume of aqueous outflow per unit of time clearly underscores that outflow is exquisitely sensitive to fluctuations in venous pressure. Because an elevation in venous pressure results in an increased volume of ocular blood as well as decreased aqueous outflow, it is obvious that considerable increase in IOP occurs with any maneuver that increases venous pressure. Hence, in addition to preoperative instillation of miotics, other anesthetic objectives for the patient with glaucoma include perioperative avoidance of venous congestion and of overhydration. Furthermore, hypotensive episodes are to be avoided because these patients are purportedly vulnerable to retinal vascular thrombosis.

Although glaucoma usually occurs as an isolated disease, it may also be associated with such conditions as Sturge-Weber syndrome, aniridia, mesodermal dysgenesis syndrome, retinopathy of prematurity, Refsum's syndrome, mucopolysaccharidosis, Hurler's syndrome, Stickler's syndrome, Marfan's syndrome, and von Recklinghausen's disease (neurofibromatosis) (Table 1-5). Additionally, ocular trauma, corticosteroid therapy, sarcoidosis, some forms of arthritis associated with uveitis, and pseudoexfoliation syndrome can also be associated with secondary glaucoma.

Primary closed-angle glaucoma is characterized by a shallow anterior chamber and a narrow iridocorneal angle that impedes the egress of aqueous humor from the eye because the trabecular meshwork is covered by the iris (Table 1-6). Relative pupillary block is common in many angle-closure episodes in which iris-lens apposition or synechiae impede the flow of aqueous from the posterior chamber. In the United States, the prevalence of angle-closure glaucoma (ACG) is one tenth as common as open-angle glaucoma. In acute ACG, if the pressure is not reduced promptly, permanent visual loss can ensue as a result of optic nerve damage. It is thought that irreversible optic nerve injury can occur within 24 to 48 hours. Therefore, once the diagnosis of acute ACG has been made, treatment should be instituted immediately. Signs and symptoms include ocular pain (often excruciating), red eye, corneal edema, blurred vision, and a fixed, mid-dilated pupil. Consultation with an ophthalmologist should be sought immediately. Topical pilocarpine 2% is administered to cause miosis and pull the iris taut and away from the trabecular meshwork. A topical β blocker also should be considered. If a prompt reduction in IOP does not ensue, systemic therapy with an agent such as mannitol should be considered, but its potentially adverse hemodynamic effects should be weighed in a patient with cardiovascular disease. If medical therapy is effective in reducing IOP to a safe level and the angle opens, an iridotomy/iridectomy can be performed immediately, or it can be delayed until the corneal edema resolves and the iris becomes less hyperemic (Table 1-7).

TABLE 1–5 Partial Listing of Conditions Associated with Glaucoma

Ocular Conditions	Systemic Diseases
Aniridia	Chromosomal anomalies
Anterior cleavage syndrome	Congenital infection syndromes (TORCH)
Cataracts	Hurler's syndrome
Ectopia lentis	Marfan's syndrome
Hemorrhage	Refsum's disease
Mesodermal dysgenesis	Sarcoidosis
Persistent hyperplastic primary vitreous	Stickler syndrome
Retinopathy of prematurity	Sturge-Weber syndrome
Spherophakia	von Recklinghausen's disease
Trauma	
Tumor	