Chapter 122

Ocular Disorder

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The differential diagnosis of headache should include primary diseases of the eye and surrounding structures.

The relationships between the eye and headache are multifactorial. The sensory innervation of the eye and periocular region is primarily from the first division of the fifth cranial nerve. Recurrent branches of the trigeminal nerve also supply the intracranial dura, venous sinuses, and cerebral vessels. Thus, headache of nonocular cause is often referred to the eye and orbit, and pain of primary ocular origin commonly radiates to other parts of the head and face.

With few exceptions, primary ocular causes of pain tend to be associated with a red eye. A fundamental maxim is that a "white eye" is rarely the cause of a monosymptomatic painful eye (3), that is, with no other symptoms of visual, oculomotor, or pupillary abnormalities.

HEADACHE ATTRIBUTED TO ACUTE GLAUCOMA

International Headache Society (IHS) code: 11.3.1
ICD-10 code: G44.843
Short description: Glaucoma is a spectrum of eye diseases characterized by damage to the optic nerve, most often associated with increased intraocular pressure (IOP) (16). Only acute primary angle closure glaucoma (PACG) and some forms of secondary glaucoma, associated with either inflammation or neovascularization, are painful, whereas the most common form of glaucoma, primary open angle glaucoma (POAG), is not.

EPIDEMIOLOGY

The highest prevalence of angle closure glaucoma of any race is estimated at 2 to 3% of people older than 40 years (16). The prevalence in Europe and the United States is about 0.09% (16).

ANATOMY AND PATHOPHYSIOLOGY OF GLAUCOMA

Aqueous humor is produced by the ciliary epithelium of the eye at the root of the iris in the posterior chamber. It then percolates through the pupil to fill the anterior chamber and is drained out of the eye into episcleral veins through the trabecular meshwork (TM) (Fig. 122-1). The TM lies in the angle formed by the intersection of the cornea and the iris. In POAG, the angle is open and the problem of drainage results from abnormalities in the TM, leading to chronic elevations of IOP. In PACG (Fig. 122-2), the filtration angle is more acute than normal and the iris can mechanically obstruct the TM, leading to quadrupling, or more, of the IOP within hours.

Neovascularization of the iris secondary to diabetes mellitus, retinal vascular occlusion, especially central retinal vein occlusion, or chronic inflammation can lead to open or closed angle forms of glaucoma.

In glaucoma secondary to intraocular inflammation, drainage of aqueous humor is impaired by inflammatory debris obstructing the TM or by trabeculitis. In chronic cases of inflammation, neovascularization may be an added factor.

The mechanisms of pain in the secondary glaucomas is multifactorial and include level and rate of rise of IOP, liberation of pain-generating molecules, ciliary muscle spasm, and anterior segment hypoxia.

CLINICAL FEATURES

IHS diagnostic criteria (Revised International Classification of Headache Disorders [ICHD-II]) for headache attributed to acute glaucoma are as follows:

A. Pain in the eye and behind or above it, fulfilling criteria C and D
B. Raised IOP, with at least one of the following:
  1. Conjunctival injection

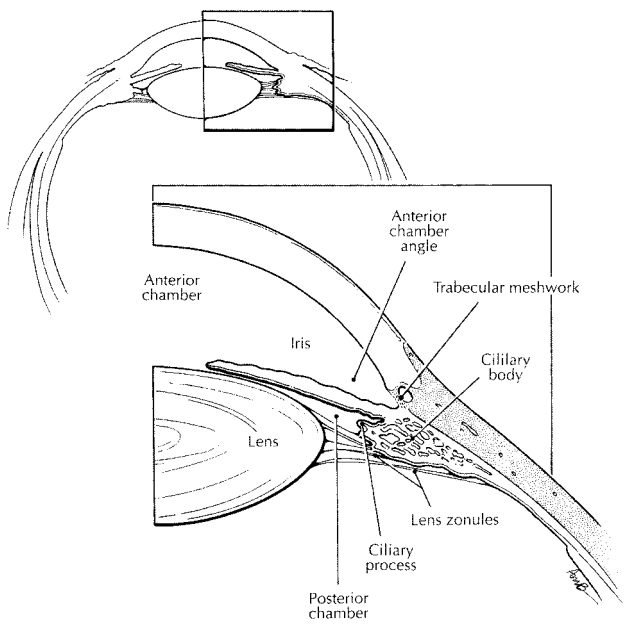

FIGURE 122-1. Anatomy of the anterior segment.

2. Clouding of the cornea
3. Visual disturbances

C. Pain develops simultaneously with glaucoma.

D. Pain resolves within 72 hours of effective treatment of glaucoma.

Acute Angle Closure Glaucoma

Acute angle closure glaucoma is an ophthalmic emergency. The pain becomes severe, boring, and located in and around the eye. Redness of the eye caused by conjunctival and episcleral vessel congestion, nausea, vomiting, bradycardia, and diaphoresis may occur. As the pressure elevates, the pupil is often mid-dilated and fixed to light, which may lead to the misdiagnosis of a posterior communicating artery aneurysm. Vision deteriorates initially from corneal edema and may be permanently impaired from anterior ischemic optic neuropathy.

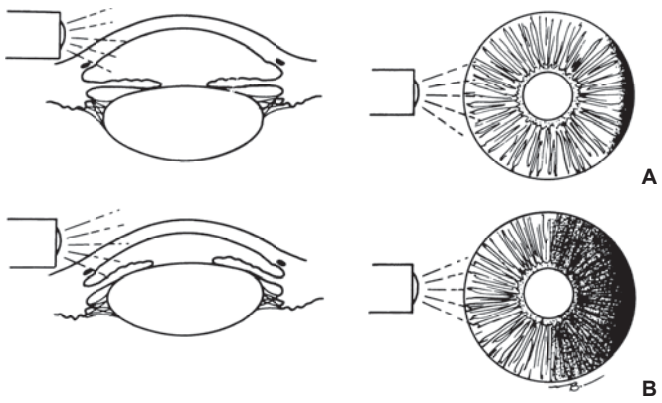

FIGURE 122-2. Penlight examination for estimating the depth of the anterior chamber. **A:** When the anterior-chamber angle is normal, a penlight directed from the side illuminates the entire iris. **B:** Forward bowing of the iris casts a shadow with side illumination in the anterior chamber with a narrow angle. From Shields MB. *Textbook of glaucoma.* 2nd ed. Baltimore: Williams & Wilkins, 1997.

Subacute Angle Closure Glaucoma

Subacute angle closure glaucoma (SACG) attacks may be asymptomatic or may present as transient episodes of blurred vision with or without a dull ache around the eye (14). The blurred vision is due to corneal edema and the symptom of colored halos around lights during an attack is quite typical. The SACG attacks occur most frequently in dark environments, because pupillary dilation is the trigger for filtration angle obstruction.

Secondary Glaucomas

The clinical presentation of these conditions is as varied as the disease or syndrome causing them. For example, in glaucomacyclitic crisis (Posner-Schlossman syndrome) the attack is acute or subacute, with pain, ocular redness, and blurred vision lasting hours to days. In neovascular glaucoma accompanying proliferative diabetic retinopathy, the pain is constant, boring, and often severe and can persist for years.

DIAGNOSIS

A definitive diagnosis is made when documenting increased IOP and narrow or blocked filtration angle with gonioscopy. Otherwise, the depth of the anterior chamber angle can be estimated with a hand light (Fig. 122-2)

PROGNOSIS

The prognosis is excellent for PACG if the diagnosis and treatment are accomplished promptly. If not, blindness or severe visual impairment can be expected. The secondary glaucomas have a more variable prognosis, dependent primarily on the underlying disease.

HEADACHE ATTRIBUTED TO REFRACTIVE ERRORS

IHS code: 11.3.2
ICD-10 code: G44.843
Short description: This somewhat controversial subject is best introduced poetically:

"Many patients have complaints
That have psychogenic taints—

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Blurring, asthenopia,
Occasional diplopia,
Aching brow and heavy lids,
Migraine headaches from the kids.
Although such things befit a 'crock'
You could become the laughing stock
Because, just possibly, the bearer
Will yield up some refractive error."
[Quoted from Milder and Rubin, p. 451 (12)]

CLINICAL FEATURES

IHS diagnostic criteria (ICHD-II) for headache attributed to refractive errors are as follows:

A. Recurrent mild headache, frontal and in the eyes themselves, fulfilling criteria C and D.
B. Uncorrected or miscorrected refractive errors (e.g., hyperopia, astigmatism, presbyopia, wearing of incorrect glasses).
C. Headache and eye pain first develop in close temporal relation to the refractive error, are absent on awakening, and are aggravated by prolonged visual tasks at the distance or angle where vision is impaired.
D. Headache and eye pain resolve within 7 days, and do not recur, after full correction of the refractive error.

The symptoms associated with refractive error are listed in Table 122-1.

Ophthalmologists use the term *asthenopia* (from the Greek: weakness of sight), or "eyestrain," to refer to these symptoms. The pain is mild, dull, aching, and often associated with the feeling that the eyes are tired, hot, uncomfortable, sore, or strained.

Only rarely does the patient report "headache." The exception is the patient with a defined primary headache disorder who notes more frequent headaches after a refractive change. Asthenopic symptoms improve or disappear when the eyes are closed or rested.

TABLE 122-1 Symptoms Suggesting That Refraction Is in Error

1. Eyes tire or "pull" with new glasses.
2. Vision is blurred at distance or near with new lenses.
3. Headaches are more intense or more frequent when wearing new glasses.
4. Sensation of nausea with new glasses
5. Objects seem tilted, too small, too big, or too sharp with new glasses.
6. Vertical lines seem to curve inward or outward.
7. Reflections are annoying.
8. Person feels off-balance when walking, especially down stairs.
9. Person owns many pairs of glasses, none of which feel correct.

Adapted from Milder and Rubin (12).

A number of refractive problems are associated with asthenopic symptoms (12). Three common problems are discussed.

Hyperopia, or farsightedness, is a condition where the native optical system of the eye focuses light behind the retina when the eye is trained at a target at an infinite distance. To see clearly, a farsighted person's lens changes shape by the process of accommodation to become stronger in converging power. Ideally, the accommodation is sufficient to focus light clearly on the retina. Even more accommodation is needed for near work such as reading. People with mild to moderate hyperopia rarely need glasses during their youth. However, if they have significantly uncorrected farsightedness, fatigue of the accommodative mechanism can lead to asthenopia. This problem becomes more bothersome as the aging process causes the human lens to lose its ability to change shape. When accommodation diminishes because of aging to the extent that comfortable focus at near is unable to be sustained, "presbyopia" is said to exist.

Presbyopia begins in the 40- to 50-year age range and becomes symptomatic earlier in an individual with hyperopia. Conversely, myopic, or nearsighted, people usually begin wearing glasses for distance at an early age and may simply remove them when reading after developing presbyopia.

Astigmatism is a condition where the cornea is not spherical but shaped more like an American football. Light is focused in two different planes behind an astigmatic cornea, and an uncorrected astigmat uses accommodation to straddle the planes of focus on the retina to minimize blur. Optical correction for astigmatism collapses the two planes into one, which is then focused on the retina. Asthenopia is often present in uncorrected astigmats. In those who wear corrective lenses for astigmatism, asthenopia becomes a problem if the prescription is changed in large degree or incorrectly. Asthenopic symptoms in astigmats commonly involve perception of visual distortion.

HEADACHE ATTRIBUTED TO HETEROPHORIA OR HETEROTROPIA (LATENT OR MANIFEST SQUINT)

IHS code: 11.3.3
ICD-10 code: G44.843
Short description: Normally, single binocular vision has overlap, in perfect register, of the majority of visual field seen with each eye. The tendency for images to slip out of register is termed **heterophoria** (or **phoria**), meaning a latent deviation of the eyes normally held in check by the fusional mechanism. Phorias are measured when fusion is inhibited (20).
Heterotropia (or **tropia**) refers to a manifest deviation of the eyes that exceeds the ability of the fusional

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GRBT050-122 Olesen- 2057G GRBT050-Olesen-v6.cls August 17, 2005 2:0

mechanism to hold the images seen simultaneously by each eye in register. Tropic persons with the ability for single binocular vision complain of binocular double vision, or diplopia. When tropias begin in childhood, the perception of diplopia is canceled by the development of suppression or amblyopia (11,20).

CLINICAL FEATURES

IHS diagnostic criteria (ICHD-II) for headache attributed to heterophoria or heterotropia:

A. Recurrent, nonpulsatile, mild to moderate frontal headache fulfilling criteria C and D.
B. Heterophoria or heterotropia has been demonstrated, with at least one of the following:
  1. Intermittent blurred vision or diplopia
  2. Difficulty in adjusting focus from near to distant objects or vice versa
C. At least one of the following:
  1. Headache develops or worsens during a visual task, especially one that is tiring.
  2. Headache is relieved or improved on closing one eye.
D. Headache resolves within 7 days, and does not recur, after appropriate correction of vision.

CLASSIFICATION

Phorias and tropias can be constant or intermittent. They may be present at distance, near, or both. They can be congenital or acquired. *Eso-* refers to eyes turned in or crossed, *exo-* to eyes turned out or divergent, *hyper-* to the higher eye, and *hypo-* to the lower eye. In general, vertical phorias and tropias are named for the higher eye. An exception is with restrictive strabismus, where the restricted eye, if lower, is called *hypotropic*.

PATHOPHYSIOLOGY

Several conditions cause phorias (11,18,20), including disorders of the eye muscles and the nerves that supply them (CN III, IV, and VI), disorders of central pathways coordinating eye movement, and combined causes. Common systemic stressors are fatigue, illness, and medications.

CLINICAL FEATURES

Headache associated with heterophorias is the same described for asthenopia. Convergence insufficiency, a form of exophoria at near, is often associated with a perception that "words run together" or "spread out" while one is reading.

TABLE 122-2 Treatments for Heterotropia and Heterophoria

Occlusion of one eye
Total: patch; clip-on occluder; tape on glasses
Partial: tape on glasses
Prisms
Temporary: Fresnel press-on prism optics
Permanent: ground-in prism
Botulinum toxin injections
Eye muscle surgery
Eye exercises (orthoptics)
For convergence insufficiency only

Adapted from Tomsak and Levine (17).

Diplopia can be associated with significant pain—*painful ophthalmoplegia*—and has a broad differential diagnosis that includes inflammatory, infectious, ischemic, neoplastic, and compressive causes (1,3,4,17).

DIAGNOSIS AND MANAGEMENT

Various ophthalmologic tools and techniques are used to diagnose and quantitate phorias and tropias (11,20).

Treatments are aimed at correcting the underlying cause for ocular misalignment (e.g., myasthenia, thyroid-associated orbitopathy, aneurysmal CN III palsy) and directly dealing with the misalignment (Table 122-2).

HEADACHE ATTRIBUTED TO OCULAR INFLAMMATORY DISORDERS

IHS code: 11.3.4
ICD-10 code: G44.843
Short description: Ocular inflammation may be caused by immune disorders, infection, trauma (blunt, chemical, or thermal), or neoplasia. The general term for intraocular inflammation is *uveitis*. Inflammations of the cornea (*keratitis*) and sclera (*scleritis*) are especially painful.

CLINICAL FEATURES

Ocular inflammations are categorized in a variety of ways, including by anatomic location, type of inflammatory response found (e.g., *nongranulomatous* or *granulomatous*), temporal profile of symptoms (e.g., *acute, subacute, chronic*), or cause (e.g., *viral, bacterial, fungal, autoimmune*) (6). Examples by anatomic location are listed in Table 122-3.

Other than posterior scleritis, most ocular inflammations result in a red eye, with the amount of vascular congestion proportional to the severity and extent of the inflammatory response. For example, in acute

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TABLE 122-3 Examples of Ocular Inflammations by Anatomic Location

Name	*Location*	*Example*
Keratitis	Cornea	Herpes simplex type 1
Acute anterior uveitis	Iris/anterior chamber	Associated with HLA-B27
Pars planitis	Pars plana of retina and anterior vitreous	Associated with MS in 10–20%
Vitreitis	Vitreous	Bacterial endophthalmitis
Retinitis	Retina	Cytomegalovirus
Choroiditis	Choroid	Tuberculosis
Scleritis	Sclera	Associated with rheumatoid arthritis
Infiltrative "masquerade" syndromes	Multiple	Leukemia, lymphoma, other malignancies

anterior uveitis the region where the cornea and sclera meet (the *limbus*) tends to be injected preferentially (*ciliary flush*). Anterior scleritis results in widespread scleral inflammation and associated conjunctival injection and edema (*chemosis*).

Photophobia is common in corneal disease and anterior uveitis and is usually accompanied by lacrimation and reflex blepharospasm. Inflammation within the eye causes toothache-like pain that is often boring and persistent. Corneal pain is most often sharp, stabbing, and very severe.

The diagnosis of ocular inflammatory disease is made by the ophthalmologist with the use of the slit-lamp biomicroscope. Consultation from other specialists is often obtained when underlying systemic diseases are suspected.

MISCELLANEOUS OCULAR DISORDERS ASSOCIATED WITH HEADACHE

A number of **orbital diseases** are associated with pain in and around the eye (Table 122-4). The diagnosis of orbital disease depends on specific signs and symptoms: the "6 Ps" (10) (Table 122-5).

Optic neuritis is associated with periocular pain and pain on eye movement in over 85% of patients. Although the pain is usually mild, it may be moderate or severe in intensity (7,13) and responds rapidly to corticosteroid treatment (13).

Phthisis bulbi is a condition where a chronically blind eye becomes atrophic and shrinks in size. Blindness in these cases occurs from the sequelae of long-standing intraocular disease such as severe glaucoma, panophthalmitis, and total retinal detachment. Phthisis bulbi is often associated with persistent boring pain. Enucleation

TABLE 122-4 Orbital Diseases Associated With Pain

Idiopathic orbital inflammation
Orbital cellulitis
Orbital hemorrhage
Orbital abscess
Arteriovenous malformations
Neoplasms
Malignant lacrimal gland tumors
Nasopharyngeal carcinoma
Squamous cell carcinoma with perineural invasion
Metastatic tumors

Adapted from Tomsak and Levine (18).

of the blind eye cures the pain in the vast majority of cases (17).

Ischemic ocular pain, or the **ocular ischemic syndrome** (OIS), results from diffuse ocular ischemia caused by distal (i.e., ophthalmic artery) or more proximal (e.g., internal carotid artery) occlusion or severe stenosis (2,5). Ischemic ocular pain occurs in 5 to 40% of patients with carotid artery occlusion.

Ipsilateral, unilateral transient visual loss in bright light may be a presenting symptom (9) and is caused by impaired photopigment metabolism. Slit-lamp examination reveals visible protein in the anterior chamber (*flare*) out of proportion to the number of the cells. Intraocular pressure is low initially. Neovascularization of the iris can occur and cause neovascular glaucoma in later stages of the disease.

Characteristic changes in the fundus, called *venous stasis retinopathy,* include intraretinal "blot" hemorrhages in the retinal midperiphery and macular areas, venous dilation, nerve fiber layer infarcts (*cotton wool spots*), and

TABLE 122-5 The Six "Ps" of Orbital Disease

Periorbital changes (e.g., swelling, redness, ptosis, lid retraction)
Proptosis (e.g., axial proptosis from lesions within the muscle cone; globe displacement up, down, in, or out from lesions outside the muscle cone)
Progression (e.g., *rapid*: infection, inflammation, leukemia, rhabdomyosarcoma; *slow*: dermoid cyst, hemangioma, optic nerve tumors; *intermittent*: orbital varix, orbital lymphangioma, mucocele)
Pain (See Table 122-4)
Palpation (anterior orbital lesions can often be palpated)
Pulsations and postural change (e.g., *pulsating exophthalmos with bruit*: carotid–cavernous fistula; *pulsating exophthalmos without bruit*: neurofibromatosis with defect in sphenoid bone; *postural changes* that increase venous pressure can magnify orbital varices)

Adapted from Krohel, Stewart and Chavis (10).

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GRBT050-122 Olesen- 2057G GRBT050-Olesen-v6.cls August 17, 2005 2:0

areas of retinal neovascularization. The fundus changes in OIS resemble background diabetic retinopathy but are unilateral and ipsilateral to the stenotic or occluded artery. Retinopathy occurs in approximately 30% of patients with internal carotid occlusion. Retinal artery pressure is very low, and the central retinal artery can be collapsed during ophthalmoscopy by gentle finger pressure on the lower eyelid (*finger ophthalmodynamometry*).

The pain of OIS is constant and localized to the brow area, face, and temple. It is often worse when the patient stands and improves when the patient is supine. In selected cases, symptoms and signs of OIS can be reversed by cerebral revascularization surgery (8,15).

The cornea and conjunctiva are two of the most pain-sensitive ocular structures. Because most diseases affecting these structures result in a red eye, tearing, blepharospasm, and photophobia, the patient is frequently referred directly to the ophthalmologist. There are two types of corneal irritation that have confusing symptoms. The first is **recurrent erosion syndrome** and results from corneal basement membrane dystrophy, which makes the corneal epithelium less adherent to it. These patients characteristically awaken with intense pain, lacrimation, and blurred vision. Presumably, eyelid movement over poorly adherent corneal epithelium gives rise to the symptoms of corneal abrasion. The diagnosis is made by observing telltale abnormalities in the basement membrane of the corneal epithelium during the slit-lamp examination. Ocular lubricants are the primary treatment.

The second corneal syndrome relates to tear film dysfunction or **"dry eyes"** (*keratoconjunctivitis sicca*). These patients usually have a feeling of mild diffuse ocular irritation with a sandy or gritty sensation, sometimes made worse when reading, when the blink rate decreases about 50%. However, some develop a brief, severe, jabbing pain sometimes described as if a pin were jabbed in the eye. The diagnosis of tear film dysfunction is made by the ophthalmologist and tear substitutes are the mainstay of treatment.

Both of these corneal conditions have symptoms similar to other defined headache syndromes (e.g., IHS 3.3, SUNCT [short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing] and IHS 4.1, Primary stabbing headache).

Primary trochlear headache (PTH) is a newly defined condition characterized by pain in the trochlear area of the orbit, worsened by upgaze and palpation of the area (22). In contrast to **trochleitis** (21), PTH is not associated with systemic disease or evidence of trochlear inflammation. Both conditions are treated with local injections of lidocaine and corticosteroids.

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