



Figure 29-25 The optic nerve in anterior ischemic optic neuropathy (AION) and papilledema. **A**, In the acute phases of AION the optic nerve may be swollen, but it is relatively pale because of decreased perfusion. **B**, In papilledema secondary to increased intracranial pressure, the optic nerve is typically swollen and hyperemic. **C**, Normally, the termination of Bruch membrane (*arrowhead*) is aligned with the beginning of the neurosensory retina, as indicated by the presence of stratified nuclei (*arrow*), but in papilledema the optic nerve is swollen, and the retina is displaced laterally. This is the histologic explanation for the blurred margins of the optic nerve head seen clinically in this condition. (**A** and **B**, Courtesy Dr. Sohan S. Hayreh, Department of Ophthalmology and Visual Science, University of Iowa, Iowa City, Ia.; **C**, from the teaching collection of the Armed Forces Institute of Pathology.)

Glaucomatous Optic Nerve Damage

As discussed, the majority of individuals with glaucoma have elevated intraocular pressure. However, there is a small group that develops the visual field and optic nerve changes typical of glaucoma with normal intraocular pressure: so-called *normal-tension glaucoma*. Conversely, some individuals with elevated intraocular pressure who are followed over long periods of time never develop visual field changes or optic nerve cupping. Therefore, it is clear that there is a spectrum of neuronal susceptibility to the effects of elevated intraocular pressure. Considerable research is now directed toward understanding mechanisms by which the optic nerve axons may be protected from injury.

MORPHOLOGY

Characteristically, there is a diffuse loss of ganglion cells and thinning of the retinal nerve fiber layer (Fig. 29-26), which can be measured by optical coherence tomography. In advanced cases, the optic nerve is both cupped and atrophic, a combination unique to glaucoma. Elevated intraocular pressure in infants and children can lead to diffuse enlargement of the eye

(*buphthalmos*) or enlargement of the cornea (*megalocornea*). After the eye reaches its adult size, prolonged elevation of intraocular pressure can lead to focal thinning of the sclera, and uveal tissue may line ectatic sclera (*staphyloma*).

Other Optic Neuropathies

Optic neuropathy may be inherited or may be secondary to nutritional deficiencies or toxins such as methanol. Individuals may suffer severe visual compromise. If the nerve fibers that originate from the macula are affected then central visual acuity is lost.

Leber hereditary optic neuropathy results from inheritance of mitochondrial gene mutations (Chapter 5). Since neuronal health is dependent on axoplasmic transport of mitochondria, mitochondrial dysfunctions give rise to neurologic disorders including optic neuropathy. Lebers optic neuropathy, shows maternal inheritance pattern typical of mitochondrial gene mutations. However, due to unclear reasons, male are affected far more commonly (9:1) than females. The usual age of onset is between 10 and 30 years. It begins with clouding of vision that may progress to total loss of vision.

Optic Neuritis

Many unrelated conditions have historically been grouped under the heading of optic neuritis. Unfortunately, the term itself suggests optic nerve inflammation, which might not accurately describe the pathophysiologic changes. In common clinical usage the term *optic neuritis* is used to describe a loss of vision secondary to demyelination of the optic nerve. One of the most important causes of optic neuritis is multiple sclerosis (Chapter 28). Indeed, optic neuritis may be the first manifestation of this disease. The 10-year risk of developing multiple sclerosis after the first attack of optic neuritis increases if the affected person has concomitant evidence of brain lesions as detected by magnetic resonance imaging. Individuals with a single episode of optic nerve demyelination may recover vision and remain disease free.

KEY CONCEPTS

- The term “**anterior ischemic optic neuropathy**” refers to a spectrum of ischemic injuries to the optic nerve varying from transient ischemia to infarction.
- Bilateral swelling of the optic nerve head known as **papilledema** may develop as a consequence of elevated cerebrospinal fluid pressure and stasis of axoplasmic transport within the optic nerve. Unilateral optic nerve head swelling may result from compression of the optic nerve such as in primary tumors of the nerve.
- In **chronic glaucoma**, the optic nerve may atrophy and the cup on the surface of the nerve may enlarge and deepen.
- **Optic neuropathy** may be inherited (as in Leber hereditary optic neuropathy) or may result from nutritional deficiencies or toxins such as methanol.