What Can We Expect in Neuro-ophthalmology in the Next Century?

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Since it is quite unlikely that the advances made in neuro-ophthalmology could have been foreseen 100 years ago, it would be hubris to predict what lies ahead in the next 100 years. It is safer to confine myself to what I hope will and will not happen.

The restoration of vision to patients condemned to neural blindness should be one of our goals in the 21st century. At the close of the 20th century, preliminary achievements in 3 areas of research permit us to be optimistic that this goal can be achieved. Research on neurotransmitters and apoptosis has suggested that there are pharmacological means by which the vitality of retinal ganglion cells might be sustained in the face of axonal injury. Such neuroprotective agents are already being tested in animal models. Neural regeneration is a second area of promising research. Mature neurons in the adult retinogeniculocalcarine pathway have been assumed to be incapable of regeneration, thus presenting a major barrier to the recovery of function after the occurrence of optic nerve lesions. While neurons in the visual pathways have yet to be regenerated, investigators have not only succeeded in regenerating optic nerve axons in mammals, but also have reestablished synaptic connections between those axons and cells in the brain proper. The third area is electronics. Collaboration between electrical engineers and physicians has led to the development of visual neural prostheses. Several groups are creating electronic-biological interfaces that can literally short-circuit damaged portions of the visual pathway. Artificial photoreceptors have been implanted in acute experiments in several patients with retinal degeneration, although so far without the results that one would desire. I hope and expect that pharmacological neuroprotection, optic nerve regeneration, and visual electronics will continue to be themes in 21st-century research.

Another problem as frustrating to the neuro-ophthalmologist as patients with irreversible neural blindness is our inability to prevent loss of vision in patients genetically predisposed to optic neuropathies. Mitochondrial DNA analysis can identify individuals harboring the mutations associated with Leber hereditary optic neuropathy before vision is lost, but we know neither how to prevent visual loss nor how to interrupt it once it has begun. After Leber disease has claimed the patient’s first eye the second will inevitably succumb, a sequence of events that proceeds as inexorably as the events in a Greek tragedy. I hope that through gene therapy, the identification and modification of epigenetic factors, or some as yet unanticipated form of treatment, 21st-century clinicians will be able to forestall visual loss in genetically predisposed patients.

Perimetry should remain one of the most reliable clinical means of localizing lesions in the visual pathways. Unfortunately the sophisticated techniques in wide use are still subjective and time-consuming. Few patients tolerate the testing with equanimity and none of the techniques permits accurate testing in infants, young children, and uncooperative adults. It is not unrealistic to anticipate that during the next century automated techniques will be developed that would allow accurate, rapid, objective mapping and quantification of sensitivities throughout the field of vision. Perhaps this will be ac-

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complished through modification of the visual evoked response test. Certainly the visual field defects thus identified could also be interpreted by automated means.

Neuro-ophthalmologists devote much of their time to the eye manifestations of neurological disorders such as stroke, migraine, and multiple sclerosis. I would hope that these disorders, whose etiology and pathogenesis have been intensively investigated in the last half of the 20th century, will yield to these efforts in the 21st. Perhaps they will virtually disappear, going the way of smallpox, poliomyelitis, and rheumatic heart disease. Of course any student of medical history knows that they will be replaced by new diseases that will present unforeseen challenges to the clinician and investigator. We can also expect that the revolution in neuroimaging that has occurred in the last several decades will continue. The next generation of clinicians will be equipped with technologies that will expand the spectrum of brain lesions that can be confidently localized and identified. Display of histological details might even become routine. As functional neuroimaging evolves, there is every reason to expect that it will allow clinicians to determine the presence, site, and nature of neural dysfunction.

Economic pressures, the use of nonphysicians, and an increasing reliance on laboratory tests have reduced the time that an ophthalmologist spends with each patient. History taking is often delegated to ancillary personnel or is substituted for by a questionnaire. In most of the ophthalmic subspecialties these changes have probably not impaired the accuracy of diagnosis or the outcome of treatment, because eye lesions are evident by inspection. But in neuro-ophthalmologic disorders the history remains essential. Results of the physical examination may be normal or may only reveal abnormalities which, taken alone, fail to unambiguously indicate the locus or nature of the disease process. History taking is a dynamic process that requires an adept interrogator who can suit the questions to the age, educational level, intelligence, and emotional state of the patient. One never knows the direction a history will take. A good history is “custom-made”; there is no place in neuro-ophthalmology for “one size fits all” histories. I cannot imagine that a technology will ever be devised that can match a human’s capacity to take a good history and I hope that the art of history taking will be preserved in the 21st century.

Medical information is being acquired at an accelerating pace. There is every reason to expect, extrapolating from the trajectory of the advances in neuro-ophthalmology in the 20th century, that in the next 100 years all that I hope for and more will be achieved.

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A look at the past . . .

To-day, Sept. 13, 1898, when I had returned the final proof to the publishing office, Mrs John J. Gillette, aged seventy-six, whose case is described on pages 467-469 as having lost, or almost lost, her sight by the occurrence of glaucoma after a discussion of the capsule, presented herself again with her eye free from inflammation, T and F normal, cornea, iris, and half the pupil clear (the other half being occupied by the dislocated thickened capsule), fundus details visible, though still somewhat veiled, no excavation or other abnormality; showing on cursory examination S 20/200, reading J. 4. Thus, her eye is not lost, but with proper cylindrical correction and complete clearing of the vitreous it promises to obtain 20/50 or better vision.