Pearls of Glaucoma Management

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Springer

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ISBN: 978-3-540-68238-7 e-ISBN: 978-3-540-68240-0

DOI: 10.1007/978-3-540-68240-0

Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2009926015

Cover design: eStudio Calamar, Figueres/Berlin

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Foreword

If you have ever uttered the commonly expressed lament, "Glaucoma is so confusing!" then this text is for you. You will no longer be bewildered.

Why practitioners may be confused about how to be of help to patients with glaucoma – in its many incarnations and reincarnations – is easily understood. The issue seems to be overwhelming when one considers that the already massive population of those with glaucoma is increasing rapidly as the world's population increases and ages.

During the past 50 years the fundamental definition of glaucoma has changed almost 180°, and the indications for treatment have become more variable and controversial, some advising early therapy and others strongly cautioning against such an approach: Various diagnostic tests have come and gone and are interpreted in such different ways that there seems to be no consensus; surgical techniques come in and out of fashion in perplexing ways. There seems to be a constantly shifting, sandy foundation on which are built unsteady schools of ever-varying advice. Why practitioners, patients, and the public are often bewildered is understandable.

The current text was designed to be relevant, scientific, and practical. The editors have accomplished their objective well. The authors chosen to share their wisdom are expert practitioners who recognize the dangers of basing treatment on theory. They, the leaders in their fields, create an understanding of glaucoma and conditions related to glaucoma that is sound, scientific, and effective. The editors clearly instructed their contributors to avoid speculation, to be practical, and to insist on evidence, not opinion (and where good evidence was lacking, to indicate such a lack). The result is a cohesive picture that should be of immense help to all those trying to make sense of what to many seems to be confusing.

It is perhaps not surprising that this text accomplishes its objective so admirably. The senior editor is a vastly experienced physician, equally at home in the clinic, the operating room, the classroom, and in a basic research laboratory. The contributing authors come from many different institutions and cultures; some are younger and others older. The current text, however, does not present information that must be sifted by a discerning reader in order to come up with appropriate advice. Rather, the authors simplify, clarify, organize, and explain practically and scientifically. Those wanting to know how to approach patients with glaucoma or those many, many patients in whom it is not clear whether glaucoma is present or not will find this a treasure trove of sound science blended with critical experience.

The need for this intellectually vigorous, practical approach to caring for patients with conditions related to intraocular pressure and optic nerve disease is great. There is probably truth in the belief that all persons will eventually develop glaucoma if they

live long enough. As the world population ages and increases, as resources become ever more precious, as cost considerations become more confining, there is increasing urgency for guidelines that concentrate on the essentials and that will help achieve the goal of caring for the sick and for the well, specifically, the greatest good for the greatest number, while still addressing the needs and wants of each individual person.

Currently there is much interest in "translational research." This book is highly successful in translating vast amounts of disparate, sometimes disconcerting information into understandable sentences, paragraphs, and illustrations that will result in more effective and more relevant care.

Pennsylvania, USA George Spaeth

Preface

This book was developed based on the questions that clinicians taking care of glaucoma patients, fellows, and residents have asked us as consultants. Most textbooks on glaucoma provide a broad overview of the basic science and clinical literature, which is very useful for students learning about glaucoma. However, these textbooks may leave many questions unanswered for the clinician specifically searching for advice on how to manage a specific problem. We have intentionally included topics that are not yet traditionally found in textbooks, such as new surgical technologies and measurement of optic nerve blood flow, because these and other areas are being discussed at meetings, and clinicians have specific questions about them.

In addition to asking the questions that frequently arise in managing patients with glaucoma, the goal of this textbook was to have the authors who are familiar with the world literature digest that information in the context of their own clinical experience. We asked authors to answer questions the way they might answer a physician's questions over the phone. We asked them to state their opinions on how they like to manage clinical situations, where appropriate, but to also point out that their preferred management is not the only way to manage the problem if other acceptable means are available. The questions are organized by topic and cover diagnostic testing and interpretation, risk factors, medical treatment, procedural treatments, various glaucoma subtypes, and complications.

We must thank all the consulting physicians, students, residents, and fellows who we have encountered, and who inspired this text. Special thanks to Ms. Trini Phan who helped jump-start this project by sending out the invitations to contribute to our world-expert authors, and to Mr. Doug Hoffman whose technical assistance was invaluable.

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Abbreviations

ACC	Acute angle closure
ACG	Angle closure glaucoma
AGIS	Advanced Glaucoma Intervention Study
AL	Axial length
ALT	Argon laser trabeculoplasty
APON	Acquired pit of the optic nerve
AUC	Area under the receiver operating curve
BAK	Benzalkonium chloride
CAI	Carbonic anhydrase inhibitor
CCT	Central corneal thickness
C/D	Cup-to-disc ratio
CDI	Color Doppler imaging
CDR	Cup-to-disc ratio
CH	Corneal hysteresis
CIGTS	Collaborative Initial Glaucoma Treatment Study
CLBF	Canon laser blood flowmetry
CNTGS	Collaborative Normal Tension Glaucoma Study
CSLO	Confocal scanning laser ophthalmoscopy
CTD	Congenital tilted disc
dB	Decibels
DCT	Dynamic contour tonometer
ECD	Endothelial cell density
ECM	Extracellular matrix
ECP	Endoscopic cyclophotocoagulation
EGPS	European Glaucoma Prevention Study
EMGT	Early Manifest Glaucoma Trial
FBCF	Fornix based conjunctival flap
FDT	Frequency doubling technology perimetry
5FU	5-Flurouracil
GAT	Goldmann applanation tonometry
GATE	German adaptive threshold estimation
GCP	Glaucoma change probability
GDD	Glaucoma drainage device
GDX	Brand name of machine that performs scanning laser polarimetry
GDX-ECC	GDX with enhanced corneal compensation
GDX-NFA	GDX nerve fiber analyzer
GDX-VCC	GDX with variable corneal compensation

GHT	Glaucoma hemifield test
GPA	Guided Progression Analysis
GPS	Glaucoma Probability Score
HRP	High pass resolution perimetry
HRT	Heidelberg retinal tomography
HFA	Humphrey visual field analyzer
HRF	Heidelberg retinal flowmeter
ICE	Iridocorneal endothelial syndrome
ILM	Inner limiting membrane
IOP	Intraocular pressure
ISNT	Mneumonic for the thickest (inferior) to thinnest (temporal) neuroretinal rim
LASIK	Laser in situ keratomileusis
LBCF	Limbal based conjunctival flap
LDF	Laser Doppler flowmetry
LPI	Laser peripheral iridotomy
LTP	Laser trabeculoplasty
MD	Mean deviation
mf ERG	Multifocal electroretinogram
mf VEP	Multifocal visual evoked potential
MMC	Mitomycin-C
MPHSD	Mean pixel height standard deviation
MRA	Moorfield regression analysis
MTD	Myopic tilted disc
NFI	Nerve fiber index (used on GDX)
NFL	Nerve fiber layer
NFLT	Nerve fiber layer thickness
NTG	Normal tension glaucoma
NV	Neovascularization
NVG	Neovascular glaucoma
OAG	Open angle glaucoma
OBF	Ocular blood flow
OCT	Optical coherence tomography
OHTS	Ocular Hypertension Treatment Study
OND	Optic nerve drusen
ONH	Optic nerve head
ONTT	Optic Neuritis Treatment Trial
OPA	Ocular pulse amplitude
OPP	Ocular perfusion pressure
ORA	Ocular response analyzer
PAS	Peripheral anterior synechiae
POAG	Primary open angle glaucoma
POBF	Pulsatile ocular blood flowmeter
PPA	Peripapillary atrophy
PSD	Pattern standard deviation
PXF	Pseudoexfoliation
RBP	Rarebit perimetry
RGC	Retinal ganglion cell
RNFL	Retinal nerve fiber layer

RPE	Retinal pigment epithelium
RVA	Retinal vessel analyzer
SAP	Standard automated perimetry
SD	Standard deviation
SD-OCT	Spectral domain optical coherence tomography (also known as Fourier domain OCT)
SITA	Swedish Interactive Threshold Algorithm
SLO	Scanning laser ophthalmoscope
SLP	Scanning laser polarimetry
SLT	Selective laser trabeculoplasty
SWAP	Short wavelength automated perimetry
SWS	Sturge Weber syndrome
TCA	Topographical change analysis
TCP	Transcleral cyclophotocoagulation
TOP	Tendency oriented perimetry
TSNIT	Temporal, superior, nasal, inferior, temporal
VA	Visual acuity
VCDR	Vertical cup to disc ratio
VF	Visual field
VFI	Visual field index
ZEST	Zippy estimation by sequential testing
3D	3-Dimensional

Optic Nerve: The Glaucomatous Optic Nerve

1

Claude F. Burgoyne

Core Messages

- The principle insult in glaucoma occurs within the neural, cellular, and connective tissues of the optic nerve head (ONH).
- Intraocular pressure at all levels has biomechanical effects on the optic nerve tissues.
- Clinical cupping is one manifestation of the pathophysiology of glaucomatous damage, but is not the pathophysiology itself.
- The variable appearance of the ONH in all optic neuropathies is the predictable result of ONH tissue biomechanics.
- As our clinical tools for characterizing ONH biomechanics improve, so too will our ability to understand normal ONH aging and its contributions to the clinical behavior and susceptibility of the ONH.

1.1 Why Is the Optic Nerve Important in the Diagnosis and Management of Glaucoma?

Glaucoma is an optic neuropathy. Although there are several pathophysiologies that must be managed in the clinical care of the glaucoma patient, what defines all forms of glaucoma is an optic neuropathy that demonstrates classic and recognizably variable [1–6] structural and functional behaviors.

1.1.1 The Optic Nerve Head (ONH) Is the Principal Site of Glaucomatous Damage to the Visual System

Although glaucomatous damage likely encompasses important pathophysiology within the retinal ganglion cell (RGC) stroma [7–12], photoreceptors [13–17], lateral geniculate body [18–20], and visual cortex [20], strong evidence suggests that damage to the retinal ganglion cell axons within the lamina cribrosa of the ONH [21–26] is the central pathophysiology underlying glaucomatous vision loss. Recent studies in monkeys [25–30], rats [31–33], and mice [34] support the importance of the ONH in glaucoma by describing profound alterations at the earliest detectable stage of the disease within the prelaminar, laminar, and peripapillary scleral tissues of the ONH.

The ONH tissues make up a dynamic environment wherein 1.2–2.0 million RGC axons converge, turn, and exit the eye through the inner (Bruch's membrane opening) and outer (scleral) portions of the neural canal (Fig. 1.1). Within the scleral portion of the canal, the bundled axons pass through a 3-dimensional meshwork of astrocyte-covered, capillary-containing connective tissue beams known as the lamina cribrosa (Fig. 1.1). Within the lamina, axonal nutrition is dependant upon the movement of oxygen and nutrients from the laminar capillaries, through the laminar beam extracellular matrix (ECM), into the laminar astrocyte processes within the beam, finally reaching the peripheral and central axons of each bundle, via cell processes [35].

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J. A. Giaconi et al. (eds.), *Pearls of Glaucoma Management,*
DOI: 10.1007/978-3-540-68240-0_1,