Glaucoma

Conceptions of a Disease

Pathogenesis, Diagnosis, Therapy

Edited by Klaus Heilmann, München
and Kenneth T. Richardson, Houston/Texas
Anchorage/Alaska

Foreword by Hans Goldmann, Bern
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With Contributions by:

E. Aulhorn, Tübingen
J. Barraquer, Barcelona
A. Bill, Uppsala
D. F. Cole, London
R. Dannheim, Stuttgart
J. Draeger, Bremen
D. Dueker, Boston
F. Fankhauser, Bern
L. Gordon, Palo Alto
P. Graham, Cardiff
E. Greve, Amsterdam
S. S. Hayreh, Iowa City
K. Heilmann, München
P. Henkind, Bronx
J. Hetherington, Jr., San Francisco
O. Hockwin, Bonn
H. D. Hoskins, San Francisco
K. Jessen, Berlin
H.-R. Koch, Bonn
A. E. Kolker, St. Louis
T. Krupin, St. Louis
A. Lobstein, Strasbourg
A. I. Mandell, Memphis
S. M. Podos, New York
K. T. Richardson, Houston
Anchorage
H. Riedel, Oberkochen
J. W. Rohen, Erlangen
R. Simmons, Boston
G. L. Spaeth, Philadelphia
H.-J. Thiel, Kiel
J. Urquhart, Palo Alto
D. I. Weiss, Bronx
D. M. Worthen, San Diego

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Foreword

Hans Goldmann

The editors asked me to write a foreword. Therefore I became the first reader of this book, an old reader of a book written above all by young people. Their self-confidence sometimes provokes criticism; often history is not in their line. However, a foreword is not the place for criticism, which can be left to later readers. If my own reaction to the book had been mainly critical, I should have refused to write a foreword. On the contrary, I have learned a great deal from it: firstly, how much progress has been made in recent years from groping hypotheses toward detailed knowledge. Then, something very disturbing: when we read the chapters by Richardson, Graham, Spaeth and Aulhorn, or even Drance's epilog, it becomes alarmingly clear how uncertain the early diagnosis of open-angle glaucoma is even today, and how much mischief has been done in this respect. One might even say that, whereas formerly people became blind as a result of glaucoma, today they are treated for an open-angle glaucoma they do not have (even though we have much better tonometers, or maybe just because of this?). If this is so, something must be wrong with our fundamental concepts. The idea of a new analysis of them suggests itself. We shall attempt one.

There is no doubt today what a fully developed chronic open-angle glaucoma is. Three symptoms characterize it: *increased intraocular pressure, characteristic loss of visual field, glaucomatous excavation of the optic disk.* Even if only two of these are present, the diagnosis is presumed to be practically certain. In the following we shall proceed formalistically and first recklessly postulate a definition of what an open-angle glaucoma *should* be, with the one condition that each concept in the definition be measurable (naturally subject to the errors of any measurement). Whatever corresponds to our definition we shall call "glaucoma"; whatever does not correspond to it is not "glaucoma." "Glaucoma" is that chronic eye disease in which IOP is too high to allow normal visual function to be maintained permanently. Hence, "too high" means a pressure that is damaging with time and not one that is statistically rare. Therefore an applanation pressure of 25 mmHg is not necessarily damaging, even though it seldom occurs in the statistics for the population as a whole. In exceptional cases a pressure of 15 mmHg can lead to damage, even though it is commonly found. No doubt the following statements are valid: (1) the higher the pressure, the more probable it is that it will lead to damage; (2) if, in the course of time, the IOP increases, the probability that it will cause damage will also increase.

What does "damage to visual function" imply in connection with our definition? It is a very special kind of loss of visual field, beginning with small paracentral scotomas, and ending with temporal remnants. Can we diagnose "glaucoma" from the visual field alone? No. The only justified diagnosis is one of suspected "glaucoma," and increasingly so, the more characteristic the visual field defect. Yet even then it may be a case of, for instance, binasal hemianopia. So for the time being we can only establish a frequency distribution of the scotomas, as we used to do with the pressure.

Finally, there are also the objective symptoms of glaucomatous damage on the fundus: no change in the rest of the fundus, only the more or less marked cupping of the optic disk and possibly a halo glaucomatosus. Again, we can compile statistics of the configuration of the optic disk, ignoring what is known about the pressure or the visual field, and obtain the distribution of increasing excavations. To the question which of these are "glaucomatous" we can only give an answer of probabilities; for excavations may also be hereditary, without implying glaucoma, and in highly myopic eyes the changed configuration of the optic disk may even largely conceal glaucomatous cupping.

Each of the three criteria mentioned – pressure, visual field, excavation – are more or less easily measurable. An insight into their distinctive features may be gained from their respective phenomenology.

Intraocular pressure: There is no *one* ("the") pressure; there are only pressures that vary over the day, over days and weeks, in any one person. From

these we can find average pressures. But do three hours at 30 mmHg, seven hours at 26 mmHg, and fourteen hours at 22 mmHg (an average of 24.2 mmHg) have the same damaging effect as ten hours at 27 mmHg, ten hours at 24 mmHg, three hours at 18 mmHg, and one hour at 16 mmHg (again an average of 24.2 mmHg) in the same patient? We know absolutely nothing about it, not to mention how it is in different patients (the same applies with regard to the diurnal change of blood supply to the optic disk correlated to the pressure). Furthermore, an "average pressure higher than" by no means implies that this pressure will increase with time. It may do so, but as every experienced ophthalmologist knows, the IOP can also decrease, which again does not imply decrease to below a damaging threshold value. Bearing in mind that we have *defined* that the damage in "glaucoma" is dependent on pressure, we are nevertheless unable to determine the damage by pressure measurements, because we cannot integrate the varying pressures (since there is no such thing as "the pressure") to constitute a reliable measure of damage.

Visual field: Is a definite defect in the visual field really proof that visual function is currently being impaired? No. The visual field merely shows that damage has occurred over a shorter or longer period of time and, in contrast to the pressure, records its accumulation. But the state of visual function remains more or less impaired even if damage stops. Only a *change* of a visual field defect with time, that is its progression, proves that damage is continuing. However, the measured assessment of slight changes in the visual field is not easy.

Optic nerve: Almost the same can be said of the glaucomatous excavation of the optic disk (measured, e. g., as cup/disk ratio) as of the visual field. It is an objective indication of functional damage recorded only by subjective methods. However, the connection between "subjective" damage of the visual field and "objective" changes in the optic disk is not a simple one. Characteristic of continuing damage is the *change* (progression) in the cup/disk ratio with time while the average pressure level remains constant. Only relatively large cup/disk ratios are well correlated to the visual field defects. However, changes in the configuration of the optic disk must begin before any cupping becomes visible; everything suggests that this change in configuration precedes the subjective symptoms of damage which are detectable at the present time.

If it is certain that each of the three measurable parameters (IOP, changes in the visual field, changes in the degree of cupping of the optic disk) indicates the existence of a "glaucoma" with some probability, then the diagnosis becomes almost certain when two parameters are combined. However, the combination of changes in the visual field with changes in the optic disk clearly does not include the pressure. A disease that leads only to a progressive characteristic alteration of the visual field, accompanied by an increase in the cup/disk ratio, will not correspond to our definition of "glaucoma." Only if a lowering of the pressure by a procedure which influences exclusively the pressure-governing mechanism of the anterior segment of the eye (pilocarpine, cholinesterase inhibitors, trabeculectomy, etc.), brings the progression of damage to the visual field or optic disk, respectively, to a standstill, is it proved that we have before us a picture of the disease corresponding to our definition. The therapy has become part of the diagnosis.

Now we can return to the problem of the early diagnosis of "glaucoma". It should lead *quickly* to a selection of suspected cases, and to *certain* detection of the cases to be treated. Having stated that, we cannot get on without considering the time factor. The *change* in the visual field or the configuration of the optic disk is decisive. This change should be ascertained as directly as possible and should not merely be inferred indirectly. If we consider the difficulties inherent in perimetry and if we note that waiting for functional damage (we are still speaking here of early diagnosis!) is a very poor form of prophylaxis, one method positively suggests itself, namely "stereochronoscopy" of the optic disk*.

The patient's optic disk is photographed at intervals, always in precisely the same position: two pictures taken some time apart are put into a stereoscope and examined binocularly. Changes in the configuration of the optic disk are seen as spatial effects. The shortest period of time that leads to a just detectable decrease in its volume has a characteristic value in normal eyes; various eye diseases may shorten this period.

So far we have established that a normal optic disk does not change its configuration within three years, while untouched glaucomatous eyes and some cases of apparent "ocular hypertension" al-

* [Goldmann, H., W. Lotmar: Albrecht v. Graefe's Arch. klin. exp. Ophthal. 202: 87–99, 1977]

ready presented changes in the configuration of the optic disk after some months. One problem now comes to the fore: What happens during the "silent interval" between the onset of high IOP, or of "objective" signs of damage, and the "subjective" loss of function? Is this merely a methodological problem or is there more to it? As you can see, this book has stimulated me to reflection. If it has a similar effect on other readers, it will certainly also achieve the aim of which Heilmann writes in the chapter entitled "Concepts." I wish the book such a stimulating success.

Preface

The purpose that led to the writing of this book is outlined in the chapter "Concepts." The emphasis throughout the book is indicated in its subtitle. It is intended to provide an overview of the entire field of the glaucomas as well as an insight into their pathogenesis, diagnosis and therapy. It has been written for the practicing ophthalmologist to enable him to keep abreast of recent advances and developments in glaucoma research and to acquire the basic principles necessary for rational management in daily practice. In many instances the reader will find departures from accepted but outdated concepts. We believe these departures to be necessary.

The criteria for the selection of bibliographic references require comment. It is not practical to document every fact included in the text. Preference has therefore been given to review articles and to original contributions in controversial fields. The references were selected by the authors; the reference lists at the end of the book are grouped by chapters and alphabetically arranged.

We wish to express our appreciation for the pleasure of working with such knowledgeable, enthusiastic and cooperative authors and to thank them for making this book possible. We are greatly indebted to many colleagues – too numerous to mention by name – for their generous and constructive criticism.

Sincere gratitude is expressed to Professor Rudolf Witmer, Zürich, for permitting the chamber angle and fundus photographs to be made at his clinic and for writing the captions. We also wish to convey our gratitude to Mr. A. Würth for taking these photographs and for his expert help.

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München — Klaus Heilmann
Houston, Texas — Kenneth T. Richardson
Anchorage, Alaska

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Editors

HEILMANN, KLAUS, MD, Professor of Ophthalmology, Augenklinik der Technischen Universität München, Ismaninger Str. 22, 8000 München 80, F.R.G.

RICHARDSON, KENNETH T., MD, Professor of Ophthalmology, Department of Ophthalmology, Baylor College of Medicine, Houston, TX 77030, U.S.A.

Contributors

AULHORN, ELFRIEDE, MD, Professor and Head, Abteilung Pathophysiologie des Sehens, Augenklinik der Universität Tübingen, 7400 Tübingen, F.R.G.

BARRAQUER, JOAQUÍN, MD, Professor of Ocular Surgery, Instituto Barraquer, Laforja 88, Barcelona 6, Spain

BILL, ANDERS, MD, Professor and Head, Department of Physiology and Medical Biophysics, Biomedical Center, Box 572, 751 23 Uppsala, Sweden

COLE, DAVID F., BSc, PhD, Department of Experimental Ophthalmology, Judd Street, London WC1, Great Britain

DANNHEIM, REINHARD, MD, Professor of Ophthalmology, Daimlerstr. 12, 7000 Stuttgart 50, F.R.G.

DRAEGER, JÖRG, MD, Professor of Ophthalmology and Head, Augenklinik im Zentralkrankenhaus, St.-Jürgen-Str., 2800 Bremen, F.R.G.

DUEKER, DAVID K., MD, Instructor in Ophthalmology, Harvard Medical School, Massachusetts Eye and Ear Infirmary, Howe Laboratory of Ophthalmology, 243 Charles Street, Boston, MA 02114, U.S.A.

FANKHAUSER, FRANZ, MD, Professor of Ophthalmology, Augenklinik der Universität Bern, Inselspital, 3008 Bern, Switzerland

GORDON, LOUIS, PhD, Alza Research, 950 Page Mill Road, Palo Alto, CA 94304, U.S.A.

GRAHAM, PETER, MB ChB (Glasgow), FRCS (England), Consultant Ophthalmologist, Department of Ophthalmology, University Hospital of Wales, Heath Park, Cardiff CF4 4XW, Great Britain

GREVE, ERIK L., MD, Head Department of Glaucoma and Visual Field, Eye Clinic University of Amsterdam, Wilhelmina Gasthuis, 104 Eerste Helmersstraat, Amsterdam 1013, Netherlands

HAYREH, SOHAN S., MD, PhD, MS, FRCS (England), FRCS (Edinburgh), Professor of Ophthalmology, Department of Ophthalmology, University of Iowa Hospitals and Clinics, Iowa City, IA 52 242, U.S.A.

HEILMANN, KLAUS, MD, Professor of Ophthalmology, Augenklinik der Technischen Universität München, Ismaninger Str. 22, 8000 München 80, F.R.G.

HENKIND, PAUL, MD, MSc (ophth.), PhD, Professor of Ophthalmology and Chairman, Department of Ophthalmology, Albert Einstein College of Medicine, Montefiore Hospital and Medical Center, 111 East 210th Street, Bronx, NY 10467, U.S.A.

HETHERINGTON, JOHN, Jr., MD, Associate Clinical Professor of Ophthalmology, University of California, School of Medicine, Glaucoma Clinic A 775, San Francisco, CA 94143, U.S.A.

HOCKWIN, OTTO, Dr. rer. nat., Dipl.-Chem., Professor, Abteilung Biochemie des Auges, Klinisches Institut für experimentelle Ophthalmologie, Universität Bonn, Abbestr. 2, 5300 Bonn, F.R.G.

HOSKINS, H. DUNBAR, MD, Medico-Dental Building, 490 Post Street, San Francisco, CA 94102, U.S.A.

JESSEN, KAI, Dipl.-Phys., Physikalisch-Technische Bundesanstalt – Institut Berlin –, Abbestr. 2–12, 1000 Berlin 10, F.R.G.

KOCH, HANS-REINHARD, MD, Priv.-Doz., Klinisches Institut für experimentelle Ophthalmologie, Universität Bonn, Abbestr. 2, 5300 Bonn, F.R.G.

KOLKER, ALLAN E., MD, Professor of Ophthalmology, Department of Ophthalmology, Washington University School of Medicine, 660 South Euclid Avenue, St. Louis, MO 63110, U.S.A.

KRUPIN, THEODORE, MD, Department of Ophthalmology, Washington University School of Medicine, 660 South Euclid Avenue, St. Louis, MO 63110, U.S.A.

LOBSTEIN, ANDRÉ, MD, Assistant of Basic Sciences, University Eye Clinic, Clinique Oph-

thalmologique, 1, Place de l'hôpital, 67005 Strasbourg, France

MANDELL, ALLAN I., MD, Director Glaucoma Service, Department of Ophthalmology, University of Tennessee, Center for the Health Sciences, Memphis, TN 38103, U.S.A.

PODOS, STEVEN M., MD, Professor of Ophthalmology and Head, Department of Ophthalmology, Mount Sinai School of Medicine, Fifth Avenue and 100th Street, New York, NY 10029, U.S.A.

RICHARDSON, KENNETH T., MD, Professor of Ophthalmology, Department of Ophthalmology, Baylor College of Medicine, Houston, TX 77030, U.S.A.
Private Practice: 1016 West 6th Avenue, Anchorage, AK 99501, U.S.A.

RIEDEL, HELMUT, Wissenschaftliche Abteilung Medizinische Geräte, Carl Zeiss, 7082 Oberkochen, F.R.G.

ROHEN, JOHANNES W., MD, Professor and Head, Anatomisches Institut, Universität Erlangen-Nürnberg, Krankenhausstr. 9, 8520 Erlangen, F.R.G.

SIMMONS, RICHARD J., MD, Harvard Medical School, Massachusetts Eye and Ear Infirmary, 243 Charles Street, Boston, MA 02114, U.S.A.

SPAETH, GEORGE L., MD, Professor of Ophthalmology, Jefferson Medical College, Director Glaucoma Service, Wills Eye Hospital, 1601 Spring Garden Street, Philadelphia, PA 19130, U.S.A.

THIEL, HANS-JÜRGEN, MD, Professor of Ophthalmology, Augenklinik der Universität Kiel, Hegewischstr. 2, 2300 Kiel, F.R.G.

URQUHART, JOHN, MD, President and Principal Scientist, Alza Research, 950 Page Mill Road, Palo Alto, CA 94304, U.S.A.

WEISS, DANIEL I., MD, Associate Clinical Professor of Ophthalmology, Albert Einstein College of Medicine, Montefiore Hospital and Medical Center, 111 East 210th Street, Bronx, NY 10467, U.S.A.

WORTHEN, DAVID M., MD, Master of Arts in Education, San Diego and Veterans Administration Hospital, University of California, 3350 La Jolla Village Drive, San Diego, CA 92161, U.S.A.

Contents

Part I Glaucoma: Conceptions

Concepts

Klaus Heilmann

What does 'glaucoma' mean? We begin not with a definition, but with a question. In this book, which intends to furnish information on the present state and continuing development of glaucoma research and management, many questions will be raised. However, to furnish information implies not only the communication of knowledge but also pointing out what is unknown: hence question and doubt have their place here alongside confirmed knowledge. For where knowledge is lacking, dogmas and dogmatism should be avoided; where knowledge is insufficient, questions must be asked. We hope that many of the questions we raise here are the right ones, for we all know, that normally only the right questions lead to the right answers.

The subtitle of the book reflects our aim: to see glaucoma conceptionally and to approach some problems connected with the disease from this viewpoint. Therefore, this book will also encourage the reader to reflect which hypotheses concerning the pathogenesis, diagnosis and therapy of the glaucomas are proved or refuted by experiment, clinical experience or empirical action. At the current stage of development we believe this approach to be more promising and more helpful than that offered by a conventional textbook.

The German ophthalmologist Albrecht von Graefe, who first identified glaucoma, defined the disease as follows: "The semeiotic concept glaucoma is rooted in the increase of intraocular tension, which has repercussions on the functions of the optic nerve and retina." Von Graefe thus attributed a dominant role in the disease process to the intraocular pressure and since the definition is not restricted to the description of symptoms, but constructs a connection between cause and effect, it has forced developments in a specific direction from the very beginning. If one compares today definitions of the term 'glaucoma' coined by various acknowledged glaucoma experts, it can be seen that for the one, a raised intraocular pressure and glaucoma are synonymous, while for the other the glaucoma damage itself is an essential part of the definition. So it seems that behind a certain definition there is often a personal concept which the author found practical and which guides him in his statements and actions. Each author in this book – which brings glaucoma scientists from Europe and the U.S.A. together for the first time – has been concerned with certain aspects of the glaucoma problem and has developed personal ideas, hypotheses or concepts; the reader should keep this scientific background in mind. Thinking of this variety of concepts, my own feelings might well be put in the form of an epigram: there is no science, there are only scientists.

This book, I think, shows that in glaucoma, this complex and fascinating field of ophthalmology, the search for the "correct solutions" will continue to be long and arduous. As I mentioned above, this is of course connected with the fact that a problem cannot be solved before it is discovered.

Glaucoma and Glaucoma Suspects

Kenneth T. Richardson

The average ophthalmologist's glaucoma practice is more involved with the glaucoma suspect than with patients who have proven glaucoma damage. In the United States and probably in most other countries a majority of patients treated with anti-glaucoma eye drops are glaucoma suspects, not individuals with the established field loss and optic nerve cupping characteristic of glaucoma damage. The clinical ophthalmologist's major therapeutic effort is therefore concentrated on an attempt to prevent chronic glaucoma damage. This may or may not be commendable, depending on the success of the prophylaxis, the skill in patient selection for treatment and the hazards of such prophylactic treatment. A thorough understanding of the concept of ocular hypertension (glaucoma suspect) is of critical importance to the clinical ophthalmologist, not only because it is his area of greatest glaucoma involvement but because his judgment and skill in handling these glaucoma suspects will exercise his greatest impact – often a pivotal impact – on the life and livelihood of his "glaucoma" patients. In fact the measure of a clinical ophthalmologist's expertise in glaucoma probably rests in his ability to grasp fully the concept "glaucoma suspect" and to apply this knowledge consistently in therapeutic decisions.

Glaucoma suspects are a perplexing group; and the cross-talk between the glaucoma specialist and the general clinical ophthalmologist has not always been fruitful because of a paradox that is often not evident. There is an important difference between the selection of glaucoma patients seen by the glaucoma specialist and the general ophthalmologist. The glaucoma specialist does not necessarily see more glaucoma patients (including suspects) than the general ophthalmologist but he sees more patients with established *glaucoma damage*. In many instances he probably sees substantially fewer glaucoma suspect cases than the clinical ophthalmologist. In my own previous, academically oriented, glaucoma practice in Pittsburgh, where all cases were referred to me from clinical ophthalmologists, only 6% of my patients could be considered glaucoma suspects. The remainder were established glaucoma patients. My present practice in Anchorage bears much greater similarity to that of a general clinical ophthalmologist and 70% of my "glaucoma" patients are suspects. This difference in practice bias makes it difficult for the glaucoma specialist to offer the same quality of experienced judgment to his clinical colleagues in questions relating to the glaucoma suspect that he can offer in questions of difficult differential diagnosis, interpretation of perimetry or disks, surgical decisions and so forth.

So the world of the glaucoma suspect is the world of the clinical practitioner of ophthalmology. There is no magic number that tells when to treat or to withhold treatment, and there is no incontrovertible evidence to substantiate the effectiveness of the large prophylactic treatment program now operational. However, there have been some excellent studies, the results of which can help us to think clearly about glaucoma suspects, help in assessing the risks to our patients, the significance of their response to reasonably safe treatment and their likelihood of compliance to a treatment schedule. In short, our judgment can probably be improved from the information available and the quality of care of the many glaucoma suspects within our practices can also be improved. What is known about the glaucoma suspect or – as some prefer – the ocular hypertensive? We know that his IOP is higher than average and therefore the risk that he will develop glaucoma damage is also higher than average.

We know that the issue is made complex because the sliding scale of pressure found in the population is pitted against the sliding scale of resistance to damage from raised IOP and that each of these may change in time quite independently of the other. Since the resistance to damage from elevated IOP is not measurable in any mathematical sense one must look for qualitative factors which seem to be associated with decreased resistance to damage and use them to aid the process of logic. A family history (1, 4, 11, 13) of *glaucoma damage* heads this list of conditions which increase risk from elevated IOP. Diabetics (7) and patients with vascular disease (9), especially those being treated with antihypertensive drugs, are probably more vulnerable. Those with pigmentary dispersion syndrome (15, 21) or pseudoexfoliation are more likely candidates for glaucoma damage and patients with large optic cups should be included in this *high risk* glaucoma suspect category unless the contrary is proven in the individual case. In sum-

mary, the factors which seem to increase the risk of glaucoma damage from elevated IOP are:

1) family history of chronic glaucoma *damage;*
2) diabetes;
3) vascular disease, especially if associated with antihypertensive therapy;
4) pseudoexfoliation;
5) pigmentary dispersion syndrome;
6) suspicious optic cups.

The means by which each of the above factors causes the patient to be more vulnerable to elevated IOP are varied and in some instances obscure; nonetheless, it is reasonably established that when these patients present as glaucoma suspects they need to be viewed with more concern and treated prophylactically with more dispatch than those patients whose resistance to damage by elevated IOP is more likely to be average.

While the variable patient resistance to glaucoma damage is for the most part not quantifiable, the glaucoma force, i.e., intraocular pressure and its diurnal variation, is readily and reproducibly measurable, and offers for the moment our only firm grip on the otherwise elusive problem of the glaucoma suspect (19). Tonography (2) and a variety of provocative tests have taught us a great deal about glaucoma and nonglaucoma *populations* and in selected cases can be helpful in defining glaucoma mechanisms, but their value in predicting which glaucoma suspect will develop optic nerve or visual field damage is nil. Hence, their use in evaluation of the glaucoma suspect is probably without merit.

Approximately 0.3 to 0.7% (5) of the population over age 60 has glaucoma damage of the optic nerve with associated visual field loss and an additional 2 to 5% are defined as glaucoma suspects on the basis of a (presumably) mean intraocular pressure of 22 mmHg or more (6, 8, 12, 14, 16, 17). This 2 to 5% level of glaucoma suspects has been documented to exist from age 40 upward, although the incidence of patients with bona fide glaucoma damage diminishes in the age groups below 60 because of the 10 to 20 year time interval necessary for the development of measurable damage in many patients.

The prevalence of glaucoma suspects (ocular hypertensives) within a population naturally varies with the pressure cutoff but even if a *mean IOP* as high as 24 mmHg is chosen as the cutoff, 2% of the population qualify. Note that the words "mean IOP" are italicized in the previous sentence. In large population studies it is proper to consider patients' pressures as a single number, since the variable diurnal pressure patterns of the individuals included in the population study and the varied pressure measurement times tend to lessen or eliminate diurnal considerations in the study *providing* the number of patients in the measured group is sufficiently large. Although this may appropriately allow a patient within a large population to be identified by a single IOP, it in no way suggests that the individual patient in the doctor's office can be identified as a glaucoma suspect by a single pressure measurement. Emphatically, he cannot be.

Valid criteria are *his* mean pressure, his low or high pressure or his diurnal pattern, according to his doctor's wishes; but a glaucoma suspect cannot be identified by his "spot check" IOP. Since the mean (6:00a.m. to 6:00 p.m.) diurnal IOP variation in glaucoma suspects is 5 to 8 mmHg, it is apparent that an occasional spot check in these patients is inadequate (10, 20, 22) and by its use the physician emasculates the value of the only quantitative and reliable measure available-indeed the measurement upon which his judgment is substantially dependent in determining whether a lifetime of prophylactic therapy is appropriate. Your response, or rather your reaction after reading this may be "Don't tell me I'm about to hear a plea for diurnal IOP measurements by the clinical ophthalmologist. That is impractical – no, it is impossible – at least in my office. Don't you understand what running a day-to-day general office is like?" Yes I do! And yes you do need to take some diurnal pressure measurements in the office if you are to gain a reasonable understanding of the glaucoma suspects in your practice. Surprisingly, in-office pressure profiles are simple, do not disrupt routine office schedule and, most importantly, they are often very helpful in therapeutic decisions. They can also be neatly combined with a therapeutic trial in selected cases, a point which is discussed later.

A frequent reaction to the suggestion of diurnals in the office is that the ophthalmologist would rather just recheck the patient's pressure at a few successive visits at different times of the day. This is probably an acceptable alternative *if it is really accomplished in an organized way*. However, even then it wastes the physician's time in many offices, since each recheck requires some doctor/patient contact time without much additional information available for the doctor to pass on to the patient. More simply, the office nurse can perform applanation measurements on a preprogrammed schedule every 2 to 3 hours during an office day.

The doctor, scheduled for one patient contact at the close of the day, will then have a reasonable profile of the individual patient's IOPs for decision and discussion. These office pressure profiles will occasionally vary with profiles on the same patient taken at different times of the month or year (although more often they do not) but in any case, and even more interestingly in these cases, they offer a better composite understanding of the IOP profile of the glaucoma suspect than helter-skelter measurements scattered over the years on a patient's record. Furthermore, periodic diurnals in the office offer the most reasonable method of defining a progressive upward trend of the glaucoma suspect's pressure profile with time *and this may prove to be the most decisive consideration in determining the need to begin prophylactic therapy.*

Since glaucoma damage occurs gradually in eyes that seem to be undamaged in youth, something must change that induces the damage. At our present level of knowledge it appears that either the pressure gradually increases over the years until it finally reaches a value which begins to compromise the functional integrity of the eye or the resistance to IOP gradually declines until it reaches a functionally vulnerable level or both.

IOP seems to increase during the aging process and progresses more rapidly than average in patients who ultimately sustain glaucoma damage. Its rate of progression in patients destined to develop functional damage is unknown. This is partly due to the fact that the glaucoma suspects usually have inadequate pressure profiles, established initially to provide valid baseline information from which to determine the existence or rate of pressure progression. Since the available evidence, both from population studies and simple logic, points toward the importance of determining whether a glaucoma suspect's pressure progresses with time (in fact there is some evidence suggesting that this finding is more important than the level of pressure itself) it is incumbent upon the clinical ophthalmologist to establish initial and periodic pressure profiles in his glaucoma suspects.

Perhaps future investigations will produce the ultimately critical test that will determine which glaucoma suspects will develop glaucoma damage unless appropriate therapy is instituted. Research efforts directed toward this goal in the past do not inspire confidence that any such critical test is on the horizon. This statement is not made cynically but humbly. It underlines the difficulty that researchers in all fields of medicine have in predicting who in the population is capable of, and who is incapable of continued normal function in the face of altered physiology. The search for a universal solution to this question has defied the most intelligent and devoted investigators in ophthalmology, just as it has defied genius in all areas of medicine and will probably continue to do so. The clinical ophthalmologists of the future will probably face a similar dilemma to that facing today's ophthalmologist in addressing the problem of the glaucoma suspect. Hopefully, as small increments in understanding occur they can be incorporated into his knowledge and subsequently into his practice, so that his approach to the glaucoma suspect will become better organized and his decisions based upon sounder judgment. But the glaucoma suspect will still represent the world of the clinical ophthalmologist; and that world will probably still be devoid of meaningful magic numbers and continue to depend for its best medical care on the intelligent judgment of the individual practicing physician.

How, then, does today's clinical ophthalmologist deal with the glaucoma suspect or ocular hypertensive? Is his approach rational? Is it safe? Is it effective? Is it likely to change? Should it change? Can it be improved upon? Anyone who would suggest he can provide the answers is mistaken, yet the questions must be asked.

Two to 5% of most adult populations are glaucoma suspects, depending on whether mean IOPs above 24 or 21 mmHg respectively are the accepted criteria. Hidden in this enormous group of glaucoma suspects (more than three million in the United States alone) (3) are 0.3 to 0.5% of the population who risk losing vision unless they can be sorted out early, treated effectively and thereby saved from one of life's great catastrophes – blindness. How the clinical ophthalmologist manages these patients is of course a statistical scenario of the same vintage as that which defines the glaucoma suspect as a patient represented by a single IOP. But it has equal validity – it defines what populations of ophthalmologists are doing to populations of glaucoma suspects and gives us an idea of how glaucoma suspects are managed.

It is estimated that 2% of the 32 million persons over age 60 in the United States and 0.5% of the 46 million between age 40 und 60 are being treated with some form of antiglaucoma medication. If one accepts that only between 0.3 and 0.5% of the population has glaucoma damage the majority of patients treated are probably glaucoma suspects. It is unfortunate, although understandable, that it has so far been impossible to

evaluate the effectiveness of this massive glaucoma prophylaxis effort. If it is effective then perhaps treatment of more glaucoma suspects is in order, since, from the best figures available, about one-half of patients with mean pressures of 24 mmHg or higher are now untreated. On the other hand, without solid evidence of the prophylactic effectiveness of treating glaucoma suspects, the psychological stress and drug side effects imposed on the patient and the gnawing concern that irreversible iatrogenic problems could occur, even if only rarely, speak against further increasing the prophylactic effort and may be an argument for reducing it. Hopefully, ophthalmologists of the future will have solid evidence to support and guide their efforts in glaucoma prophylaxis but this is unlikely for at least a decade or two. Meanwhile it is probably best to assume that – as with most human ailments – glaucoma will prove to be a disease where lack of resistance to force is more important than the force itself, except in the extreme. If this is the case then treatment directed toward patients whose pressures deviate only slightly from the norm is not justifiable; it should be withheld unless probable lack of resistance can be defined or deviation of pressure markedly above the norm exists (18).

Since medical logic and fragmentary, but very important evidence suggests that lack of resistance to elevated intraocular pressure is a primary consideration in glaucoma suspects whose pressure elevations are modest, a search for these factors by the clinician (and by researchers) is imperative. Further, it is reasonable that prophylactic therapeutic decisions should be influenced when such conditions exist. Genetically determined poor resistance to elevated IOP should be assumed when a glaucoma suspect occurs in a family where glaucomatous cupping or field loss is documented and prophylactic antiglaucoma therapy was started at pressures considerably below those which would prompt therapy in a patient with presumed normal resistance. Since inadequate blood perfusion of the posterior pole of the eye seems to be a factor in glaucoma damage, those patients with probable chronic reduced tissue perfusion such as diabetics, patients under treatment with antihypertensive drugs and possibly those with premature arteriolar sclerosis should likewise be afforded prophylactic antiglaucoma therapy for modest IOP elevations. Similarly, patients with chronic anemia and other blood dyscrasias are candidates for poor resistance but proof is lacking. Patients with pseudoexfoliation and marked pigmentary dispersion also face a higher than average risk. Even though the great majority of pigmentary dispersion syndromes have no associated elevation IOP those who do have pressure elevation seem more likely to develop damage than the usual glaucoma suspect. This is probably due to a greater propensity to develop increasing pressure with time than to greater than average susceptibility of the optic nerve to damage.

Since IOP is the only quantifiable measurement available, any logical method for therapeutic decision in glaucoma suspects must be based upon it, even though it may or may not be the most important factor in causing the glaucoma damage (Fig. 1.1).

This approach to management of the glaucoma suspect is based on the assumption that an organ in a patient with normal resistance will probably withstand a force 25–30% greater than average without developing pathologic change but that patients with predictably reduced resistance should not be expected to tolerate a force at all above average.

Further, it must take into account that patients whose IOP increases substantially with time face a higher risk than average. Glaucoma suspects have an average diurnal variation of 6 to 7 mmHg, so that to eliminate most of the false negatives on routine examination of the individual patient the cutoff level requiring a pressure profile should be 3 to 4 mmHg below the level requiring a therapeutic trial.

Available population proportion statistics for patients with presumably higher risk of glaucoma damage from elevated IOP are: diabetes 2%, antihypertensive drugs 1%, family history of glaucoma damage 1%, suspicious optic cups 2%, pigmentary dispersion syndrome 5%. Thus, 10 to 12% of glaucoma suspects are likely to have evidence suggesting a greater than average risk from ocular pressure elevation. Assuming that the pressure distribution in these patients approximates the random population – which it probably does except for those with family history of glaucoma – 256,000 (U.S.A.) would have a therapeutic trial using the previously described management approach for glaucoma suspects and most of these patients would be treated. Of the remaining 90% of the ocular hypertensive population with presumed normal resistance to damage from elevated intraocular pressure, 229,000 (U.S.A.) would be treated using the management approach illustrated above. This would reduce the total number of patients being prophylactically treated from an esti-

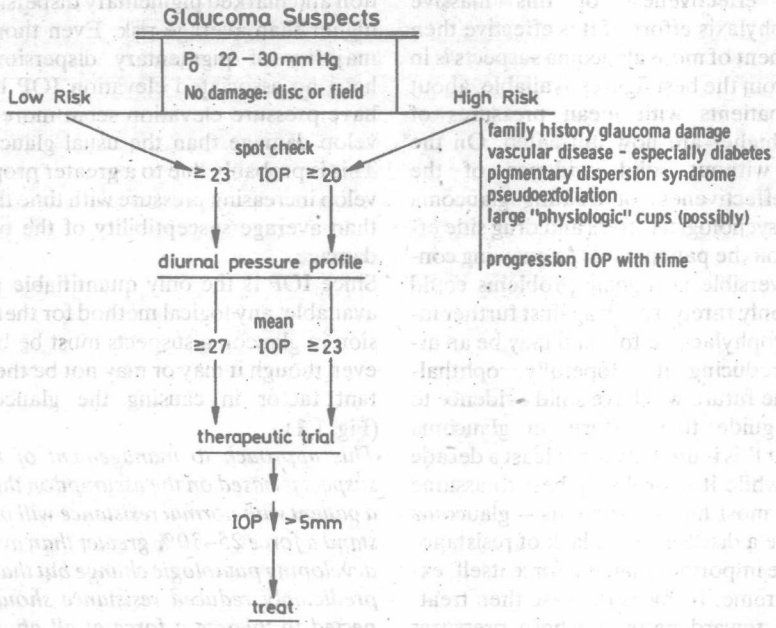

Fig. 1.1

mated 900,000 to 485,000 (U.S.A.) and markedly shift treatment emphasis to those in whom a higher risk of damage from pressure elevation is more probable or whose pressures rise progressively. This is logical and defensible, on the basis of information currently available. The need for prophylactic treatment in glaucoma suspects who have no definable decrease in resistance to glaucoma damage or other high risk factors is more conjectural. In my own view, prophylactic treatment of these presumably normal risk patients with mean pressures lower than 24 mmHg, or withholding treatment in those with mean pressures higher than 30 mmHg, is difficult to justify logically at our present level of knowledge.

Although the guidelines developed in this chapter may be useful until better data are available, each clinical ophthalmologist will still have to use his own best judgment in chosing the pressure above which he feels he is jeopardizing the safety of the individual patient, taking into account the pressure reduction achieved by treatment as well as the drug-induced side effects and possible toxicity.

(A more comprehensive view of medical treatment is given by Heilmann, p. 263.)