PREFERRED PRACTICE PATTERN®

Primary Open-Angle Glaucoma Suspect

AMERICAN ACADEMY OF OPHTHALMOLOGY
The Eye M.D. Association

Prepared by the American Academy of Ophthalmology Glaucoma Panel

Glaucoma Panel Members
Bruce E. Prum, Jr., MD, Chair
David S. Friedman, MD, MPH, PhD, American Glaucoma Society Representative
Steven J. Gedde, MD
Leon W. Herndon, MD
Young H. Kwon, MD, PhD
Michele C. Lim, MD
Lisa F. Rosenberg, MD
Rohit Varma, MD, MPH, Methodologist

Preferred Practice Patterns Committee Members
Christopher J. Rapuano, MD, Chair
David F. Chang, MD
Emily Y. Chew, MD
Robert S. Feder, MD
Stephen D. McLeod, MD
Bruce E. Prum, Jr., MD
R. Michael Siatkowski, MD
David C. Musch, PhD, MPH, Methodologist

Academy Staff
Flora C. Lum, MD
Nancy Collins, RN, MPH
Doris Mizuiri
Medical Editor: Susan Garratt
Design: Socorro Soberano
Reviewed by: Council
Approved by: Board of Trustees
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As a service to its members and the public, the American Academy of Ophthalmology has developed a series of guidelines called Preferred Practice Patterns that **identify characteristics and components of quality eye care.** (See Appendix 1.)

The Preferred Practice Pattern® guidelines are based on the best available scientific data as interpreted by panels of knowledgeable health professionals. In some instances, such as when results of carefully conducted clinical trials are available, the data are particularly persuasive and provide clear guidance. In other instances, the panels have to rely on their collective judgment and evaluation of available evidence.

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All PPPs are reviewed by their parent panel annually or earlier if developments warrant and updated accordingly. To ensure that all PPPs are current, each is valid for 5 years from the "approved by" date unless superseded by a revision. Preferred Practice Pattern guidelines are developed by the Academy's H. Dunbar Hoskins Jr., M.D. Center for Quality Eye Care without any external financial support. Authors and reviewers of PPPs are volunteers and do not receive any financial compensation for their contributions to the documents. The PPPs are externally reviewed by experts and stakeholders before publication.

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David F. Chang, MD: Advanced Medical Optics – Consultant/Advisor; Alcon Laboratories, Inc. – Consultant/Advisor; Allergan, Inc. – Lecture fees; Calhoun Vision, Inc. – Consultant/Advisor, Equity owner; Eyemaginations, Inc. – Consultant/Advisor, Patent/Royalty; Ista Pharmaceuticals – Consultant/Advisor, Grant support; LensAR – Consultant/Advisor; Hoya – Consultant/Advisor; Peak Surgical – Consultant/Advisor; Revital Vision – Equity owner; SLACK, Inc. – Patent/Royalty; Transcend Medical – Consultant/Advisor; Visiogen, Inc. – Consultant/Advisor, Equity owner

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Robert S. Feder, MD: No financial relationships to disclose.

David S. Friedman, MD, MPH, PhD: Alcon Laboratories, Inc. – Grant support; NiCox – Consultant/Advisor; Novartis Pharmaceuticals Corp. – Consultant/Advisor; ORBIS International – Consultant/Advisor; Pfizer, Inc. – Consultant/Advisor, Lecture fees, Grant support; Promedior – Consultant/Advisor; Zeiss Meditec – Grant support

Steven J. Gedde, MD: Lumenis, Inc. – Lecture fees

Leon W. Herndon, MD: Alcon Laboratories, Inc. – Consultant/Advisor, Lecture fees; Allergan, Inc. – Lecture fees; iScience – Lecture fees; Ista Pharmaceuticals – Consultant/Advisor, Lecture fees; Merck & Co., Inc. – Lecture fees; Optonol, Ltd. – Lecture fees; Pfizer, Inc. – Lecture fees; Reichert, Inc. – Lecture fees

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Michele C. Lim, MD: No financial relationships to disclose.

Stephen D. McLeod, MD: Abbott Medical Optics – Consultant/Advisor, Equity owner; Visiogen, Inc. – Consultant/Advisor, Equity owner

David C. Musch, PhD, MPH: Glaukos Corp. – Consultant/Advisor; MacuSight, Inc. – Consultant/Advisor; National Eye Institute – Grant support; NeoVista, Inc. – Consultant/Advisor; Neurotech USA, Inc. – Consultant/Advisor; OPKO Health, Inc. – Consultant/Advisor; Oraya Therapeutics, Inc. – Consultant/Advisor; Pfizer Ophthalmics – Grant support; Washington University – Grant support

Bruce E. Prum Jr., MD: Alcon Laboratories, Inc. – Grant support; Allergan, Inc. – Consultant/Advisor

Christopher J. Rapuano, MD: Alcon Laboratories, Inc. – Lecture fees; Allergan, Inc. – Consultant/Advisor, Lecture fees; Bausch & Lomb – Lecture fees; Inspire – Lecture fees; EyeGate Pharma – Consultant/Advisor; Inspire – Lecture fees; Rapid Pathogen Screening – Equity owner; Vistakon Johnson & Johnson Visioncare, Inc. – Lecture fees

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Rohit Varma, MD, MPH: Alcon Laboratories, Inc. – Consultant/Advisor, Lecture fees; Allergan, Inc. – Consultant/Advisor, Grant support; Aquesys – Consultant/Advisor, Equity owner, Grant support; Bausch & Lomb Surgical – Consultant/Advisor; Genentech, Inc. – Consultant/Advisor, Grant support; Merck & Co., Inc. – Consultant/Advisor; National Eye Institute – Grant support; Optovue – Grant support; Pfizer, Inc. – Consultant/Advisor, Lecture fees, Grant support; Replenish, Inc. – Consultant/Advisor, Equity owner, Grant support

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INTRODUCTION

The Preferred Practice Pattern® (PPP) guidelines have been written on the basis of three principles.

- Each PPP should be clinically relevant and specific enough to provide useful information to practitioners.
- Each recommendation that is made should be given an explicit rating that shows its importance to the care process.
- Each recommendation should also be given an explicit rating that shows the strength of evidence that supports the recommendation and reflects the best evidence available.

In the process of revising this document, a literature search of the Cochrane Library and PubMed was conducted on December 3, 2008 and April 28, 2009 on the subject of primary open-angle glaucoma (POAG) suspect for the years 2004 to the date of the search. In addition, the evidence synthesis[1] prepared by the British National Collaborating Centre for Acute Care for the National Institute for Health and Clinical Excellence guideline on Glaucoma: diagnosis and management of chronic open-angle glaucoma and ocular hypertension, was reviewed.[2] Details of the literature search are available at www.aao.org/ppp. The results were reviewed by the Glaucoma Panel and used to prepare the recommendations, which they rated in two ways. The panel first rated each recommendation according to its importance to the care process. This "importance to the care process" rating represents care that the panel thought would improve the quality of the patient's care in a meaningful way. The ratings of importance are divided into three levels.

- Level A, defined as most important
- Level B, defined as moderately important
- Level C, defined as relevant but not critical

The panel also rated each recommendation on the strength of evidence in the available literature to support the recommendation made. The "ratings of strength of evidence" also are divided into three levels.

- Level I includes evidence obtained from at least one properly conducted, well-designed, randomized, controlled trial. It could include meta-analyses of randomized controlled trials.
- Level II includes evidence obtained from the following:
  - Well-designed controlled trials without randomization
  - Well-designed cohort or case-control analytic studies, preferably from more than one center
  - Multiple-time series with or without the intervention
- Level III includes evidence obtained from one of the following:
  - Descriptive studies
  - Case reports
  - Reports of expert committees/organizations (e.g., PPP panel consensus with external peer review)

Evidence is that which supports the value of the recommendation as it relates to the quality of care. The panel believes that it is important to make available the strength of the evidence underlying the recommendation. In this way, readers can appreciate the degree of importance the panel attached to each recommendation, and they can understand what type of evidence supports the recommendation.

The ratings of importance and the ratings of strength of evidence are given in bracketed superscripts after each recommendation. For instance, "[A:II]" indicates a recommendation with high importance to clinical care [A], supported by sufficiently rigorous published evidence, though not by a randomized controlled trial [II].

The sections entitled "Orientation" and "Background" do not include recommendations; rather they are designed to educate and provide summary background information and rationale for the recommendations that are presented in the Care Process section. A summary of the major recommendations for care is included in Appendix 2. Appendix 3 has an algorithm for the management of POAG suspect. Appendix 4 contains the ICD-9 classifications for the disease entities that the PPP covers.

ORIENTATION

DISEASE DEFINITION

A glaucoma suspect is an individual with clinical findings and/or a constellation of risk factors that indicate an increased likelihood of developing POAG.

The clinical findings that define a glaucoma suspect patient are characterized by one of the following in at least one eye in an individual with open anterior chamber angles by gonioscopy:

- Appearance of the optic disc or retinal nerve fiber layer that is suspicious for glaucomatous damage
  - Enlarged cup-disc ratio
  - Asymmetric cup-disc ratio
  - Notching or narrowing of the neuroretinal rim
  - Disc hemorrhage
  - Nerve fiber layer defect
- A visual field suspicious for glaucomatous damage in the absence of clinical signs of other optic neuropathies
  - Arcuate bundle defect
  - Nasal step
  - Paracentral scotoma
  - Altitudinal defect
  - Larger mean pattern standard deviation
- Consistently elevated intraocular pressure (IOP) associated with normal appearance of the optic disc and retinal nerve fiber layer and with normal visual field test results

  This definition excludes known secondary causes for open-angle glaucoma, such as pseudoexfoliation (exfoliation syndrome), pigment dispersion, and traumatic angle recession.

PATIENT POPULATION

The patient population includes adults with open anterior chamber angles by gonioscopy with one or more of the clinical findings or risk factors listed in the Disease Definition section.

ACTIVITY

The identification and management of patients with POAG suspect.

PURPOSE

To detect and manage patients at risk for developing glaucoma, prevent damage to the optic nerve, and preserve patients' quality of life.

GOALS

- Document the status of optic nerve structure, by clinical evaluation and imaging, and function, by visual field testing, on presentation
- Identify patients at high risk of developing POAG
- Consider treatment of high-risk individuals to prevent or delay the development of POAG
- Minimize the side effects of treatment and the impact of treatment on the patient's vision, general health, and quality of life
- Educate and involve patients and appropriate family members/caregivers in the management of their condition

BACKGROUND

EPIDEMIOLOGY AND RISK FACTORS

Although glaucoma is not defined by IOP, and estimates of glaucoma suspects based on suspicious optic nerve or visual field findings are lacking, there are data on ocular hypertension in the United States. The prevalence of ocular hypertension in non-Hispanic Whites who are 40 and older and live in the United States is 4.5% (ranging from 2.7% in persons 43 to 49 years old to 7.7% in those 75 to 79 years old).[3] In Latinos 40 and older, the overall prevalence is 3.5% (ranging from 1.7% in persons 40 to 49 years old to 7.4% in those 80 and older).[4] There are no published population-based estimates for the prevalence of ocular hypertension in African Americans and Asian Americans. However, it is estimated that 3 to 6 million persons in the United States have ocular hypertension.[5] Furthermore, there are no estimates for the number of individuals who are considered to be glaucoma suspects based on the appearance of their optic nerve or visual field. The number of individuals with eye findings that raise a suspicion of glaucoma, usually elevated IOP or asymmetric optic disc morphology, far exceeds the number of people with glaucoma. (It is estimated that over 2.2 million persons in the United States have open-angle glaucoma.)[6]

A majority of people with ocular hypertension may be undiagnosed. Seventy-five percent of Latinos with IOP greater than 21 mmHg were previously undiagnosed in the Los Angeles Latino Eye Study.[4] The public health importance of early detection and management of these patients lies in the fact that individuals with ocular hypertension are at increased risk of developing glaucomatous optic neuropathy. The Ocular Hypertension Treatment Study (OHTS) demonstrated the rate of untreated participants developing glaucomatous optic neuropathy to be 9.5% in 5 years[7,8] and 22% at 13 years, or approximately 2% per year.[9] Glaucoma of all types is one of the most common causes of legal blindness in the United States.[6,10]

The overall likelihood of ***developing*** glaucomatous optic neuropathy increases with the number and relative strength of risk factors, which include the following:

- Higher IOP[7,8,11-20]
- Older age[7,8,13,14,21-23]
- Family history of glaucoma[14,24]
- Lower ocular perfusion pressure[24]
- Lower systolic and diastolic blood pressure[24]
- Thinner central cornea[7,8]
- Disc hemorrhage[25-29]
- Larger cup-to-disc ratio[7,8]
- Larger mean pattern standard deviation on threshold visual field testing[20,30]

While disc hemorrhage, increased cup-disc ratio and larger mean pattern standard deviation are considered to be risk factors for the development of POAG, it can also be argued that these signs represent early optic nerve damage and unsuspected glaucoma.

Some studies have shown an association between type 2 diabetes mellitus and a higher prevalence[31-35] and incidence[36] of open-angle glaucoma; however, other studies[17,37,38] have not found such a relationship. The preponderance of the evidence suggests that type 2 diabetes mellitus is associated with a higher prevalence of open-angle glaucoma.[35]

Other risk factors that have been associated with open-angle glaucoma include migraine headache, peripheral vasospasm, concurrent cardiovascular disease, systemic hypertension, and myopia.[8,39-43] However, the association between these risk factors and the development of glaucomatous optic nerve damage has not been demonstrated consistently.[8,22,44-50]

DETECTION

Patients suspected of having POAG can be identified during a comprehensive adult medical eye evaluation.[51] While an assessment of IOP can identify individuals who are ocular hypertensive, an assessment of the optic nerve and the visual field is required to identify those patients who have glaucoma with a normal IOP.

In 2005, the National Committee for Quality Assurance introduced a new quality measure for health plans that offer Medicare Advantage coverage in recognition of the importance of identifying patients with glaucoma and the difficulties of screening. The measure is based on a comprehensive eye examination in the previous 2 years for older adults. The intent of the quality measures is to allow purchasers and consumers to compare the performance of managed health plans reliably.

CARE PROCESS

PATIENT OUTCOME CRITERIA

- Preservation of visual function
- Maintenance of quality of life

DIAGNOSIS

The comprehensive initial glaucoma suspect evaluation (history and physical examination) includes all components of the comprehensive adult medical eye evaluation[51] in addition to and with special attention to those factors that specifically bear upon the diagnosis, course, and treatment of POAG. The evaluation may require more than one visit. For instance, an individual might be suspected of having POAG on one visit but may return for further evaluation to confirm the diagnosis, including additional IOP measurements, gonioscopy, central corneal thickness determination, visual field assessment, and optic nerve head and retinal nerve fiber layer evaluation and documentation.

Evaluation of Visual Function

Self-reported functional status or difficulty with vision can be assessed either by patient complaints or by specific questionnaires including the National Eye Institute - Visual Function Questionnaire-25.[52-56] [A:III]

Ophthalmic Evaluation

In completing the elements in the comprehensive adult medical eye evaluation,[51] the ophthalmic evaluation specifically focuses on the following elements:

- History[A:III]
- Visual acuity measurement[A:III]
- Pupil examination[B:II]
- Anterior segment examination[A:III]
- Intraocular pressure measurement[A:I]
- Gonioscopy[A:III]
- Optic nerve head and retinal nerve fiber layer examination[A:III]
- Fundus examination[A:III]

History

- Ocular,[A:III] family,[15,57,58] [A:II] and systemic history (e.g., asthma, migraine headache, vasospasm).[A:III] The severity and outcome of glaucoma in family members, including a history of visual loss from glaucoma, should be obtained during initial evaluation.[57,58] [B:III]

- Review of pertinent records,[A:III] with particular reference to the IOP and the status of the optic nerve and visual field[A:III]
- Ocular and systemic medications (e.g., corticosteroids) and known local or systemic intolerance to ocular or systemic medications[A:III]
- Ocular surgery[A:III]

It is important to note that a history of LASIK or photorefractive keratectomy has been associated with a falsely low IOP measurement due to thinning of the cornea.[59,60] Cataract surgery may have lowered the IOP when compared with the presurgical baseline.[61]

Visual acuity measurement

Visual acuity with current correction (the power of the present correction recorded) at distance and, when appropriate, at near should be measured.[A:III] Refraction may be indicated to obtain the best-corrected visual acuity.

Pupil examination

The pupils are examined for reactivity and an afferent pupillary defect.[62-64 [B:II]]

Anterior segment examination

A slit-lamp biomicroscopic examination of the anterior segment can provide evidence of physical findings associated with narrow angles, such as shallow peripheral anterior chamber depth and crowded anterior chamber angle anatomy,[65,66] corneal pathology, or a secondary mechanism for elevated IOP such as pseudoexfoliation (exfoliation syndrome), pigment dispersion with iris transillumination defects, iris and angle neovascularization, or inflammation.[A:III]

Intraocular pressure measurement

Results from OHTS demonstrate that lowering an elevated IOP reduces the risk of progression of glaucomatous visual field and optic nerve damage.[7 [A:I]] It is important to determine the full extent of IOP fluctuation over time to determine who is most at risk of developing glaucoma and, therefore, whom to treat to prevent future glaucoma. Intraocular pressure is measured in each eye, preferably by Goldmann applanation tonometry, before gonioscopy or dilation of the pupil.[67 [A:III]] Recording time of day of IOP measurements may be helpful to assess diurnal variation. Unrecognized IOP fluctuations may be associated with an increased risk of developing glaucomatous damage.[68-77] Therefore, additional IOP measurements may be indicated, either at different hours of the day on the same day or on different days.

Gonioscopy

The diagnosis of POAG requires careful evaluation of the anterior chamber angle to exclude angle closure or secondary causes of IOP elevation, such as angle recession, pigment dispersion, peripheral anterior synechiae, angle neovascularization, and inflammatory precipitates.[78 [A:III]] (See www.gonioscopy.org and Selected Reference Texts section for discussion of the techniques of gonioscopy.)

Optic nerve head and retinal nerve fiber layer examination

There is evidence that glaucomatous changes detected with optic disc and retinal nerve fiber layer examination may precede defects detected by standard automated perimetry.[79-85] In OHTS, optic nerve damage alone without visual field loss occurred in 69 eyes and accounted for 55% of the study endpoints reached.[7]

Examination of the optic nerve head and retinal nerve fiber layer provides valuable structural information about glaucomatous optic nerve damage.[86] Visible structural alterations of the optic nerve head or retinal nerve fiber layer and development of peripapillary choroidal atrophy frequently occur before visual field defects can be detected.[81,87-94] Careful study of the optic disc neural rim for small hemorrhages is important, because these hemorrhages can precede visual field

loss and further optic nerve damage.[25-29,95,96] In the OHTS, the incidence of POAG in eyes with disc hemorrhage was 13.6% compared with 5.2% in eyes without disc hemorrhage over 8 years.[29]

The preferred technique for optic nerve head and retinal nerve fiber layer evaluation involves magnified stereoscopic visualization (as with the slit-lamp biomicroscope), preferably through a dilated pupil.[A:III] In some cases, direct ophthalmoscopy complements magnified stereoscopic visualization, providing additional information of optic nerve detail due to the greater magnification of the direct ophthalmoscope. Red-free illumination of the posterior pole may aid in evaluating the retinal nerve fiber layer.[97]

Fundus examination

Examination of the fundus, through a dilated pupil whenever feasible, includes a search for other abnormalities that may account for optic nerve changes and/or visual field defects (e.g., optic nerve pallor, disc drusen, optic nerve pits, disc edema due to central nervous system disease, macular degeneration, retinal vascular occlusion, and other retinal disease).[A:III]

Supplemental Ophthalmic Testing

Supplemental ophthalmic testing includes the following components:

- Central corneal thickness measurement[A:II]
- Visual field evaluation[A:III]
- Optic nerve head and retinal nerve fiber layer analysis[A:II]

Central corneal thickness measurement

Measurement of central corneal thickness (CCT) aids the interpretation of IOP readings and helps to stratify patient risk for optic nerve damage.[7,8,98-100 [A:II]] Applanation tonometry on thicker than average corneas may overestimate IOP measurement, while thinner than average corneas may yield an underestimate of the true IOP.[101] Several studies have sought to quantify the relationship between measured IOP level and CCT, but there is no generally accepted correction formula. There is a controversy over whether CCT is a risk factor due to the potential for IOP under- or overestimations[102-104] or whether CCT is a risk factor itself, unrelated to IOP. There is level II evidence from OHTS that CCT is an independent risk factor for the development of POAG.[8]

Visual field evaluation

Automated static threshold perimetry is the preferred technique for evaluating the visual field.[105 [A:III]] The frequency doubling technology (FDT) method with the central 20-degree test program (C-20) and short-wavelength automated perimetry (SWAP) with the central 24-degree test program (24-2) are two of several alternative testing methods to screen for a defect before conducting more definitive threshold testing.[105] Visual field testing based on SWAP[106] and FDT[107] may detect defects or progression of defects earlier than conventional white-on-white perimetry.[108,109] Careful manual combined kinetic and static threshold testing (e.g., Goldmann visual fields) is an acceptable alternative when patients cannot perform automated perimetry reliably or if it is not available.[A:III] Repeat, confirmatory visual field examinations may be required for test results that are unreliable or show a new glaucomatous defect before changing management.[110,111 [A:III]] In the OHTS, 86% of visual field defects were not confirmed upon subsequent testing.[110] It is best to use a consistent examination strategy for visual field testing.

Optic nerve head and retinal nerve fiber layer analysis

The appearance of the optic nerve should be documented.[83,109 [A:II]] Color stereophotography is an accepted method for documenting optic nerve head appearance. In glaucoma suspect patients, longitudinal stereophotographs identified over half the cases of new onset glaucoma in OHTS[7]; this finding has been confirmed in another study.[112] Computer-based image analysis of the optic nerve head and retinal nerve fiber layer is an alternative for documentation of the optic nerve and can identify patients at greater risk of progression to glaucoma.[83,113] As improvements in these instruments continue, the capacity for them to help the clinician diagnose glaucoma and identify progressive nerve damage may become more reliable.[84,85,114] Stereoscopic disc photographs and

computerized images of the nerve are distinctly different methods for optic nerve documentation and analysis.[115] Each is complementary with regard to the information they provide the clinician who must manage the patient. In the absence of these technologies, a nonstereoscopic photograph or a drawing of the optic nerve head should be recorded, but these are less desirable alternatives to stereophotography or computer-based imaging.[116] [A:III]

There are three types of computer-based imaging devices currently available for glaucoma: confocal scanning laser ophthalmoscopy, optical coherence tomography, and scanning laser polarimetry. In a systematic review, the versions of these devices that were studied were similar in their ability to distinguish glaucoma patients from controls.[83,117] Taken together, computer-based imaging devices for glaucoma provide useful, quantitative information for the clinician when analyzed in conjunction with other relevant clinical parameters.

MANAGEMENT

Goals

The goals of managing patients with POAG suspect are to achieve the following:

- Intraocular pressure controlled in the target range
- Stable optic nerve/retinal nerve fiber layer status
- Stable visual fields

Intraocular pressure is the only modifiable parameter in glaucoma and glaucoma suspect patients. The decision to begin treatment to lower IOP in the glaucoma suspect patient is complex and based on the ophthalmologist's analysis of the examination results, risk assessment, and evaluation of the patient and the patient's preferences. The number and severity of risk factors present, the prognosis, management plan, and likelihood that therapy, once started, can be long-term, should be discussed with the patient and, when feasible, with the patient's family. Risk assessment based on OHTS and the European Glaucoma Prevention Study may be helpful in managing the patient with glaucoma suspect.[30]

The decision to begin treatment for a glaucoma suspect patient is particularly important, since therapy exposes patients to the risks, side effects, and expense of long-term treatment. For some patients, the risk of developing POAG is sufficiently high to justify starting treatment.[7,8,118] For example, in the OHTS, untreated patients with a baseline IOP of 26 mmHg or above and a CCT of 555 μm or below had a 36% chance of developing optic nerve damage during long-term follow-up compared with a 2% risk for patients with a baseline IOP of less than 24 and a CCT greater than 588 μm (see Figure 1).[6] Whether or not a patient is treated, long-term monitoring for the development of glaucoma is essential.[A:III]

The patient who is a glaucoma suspect has a chronic, asymptomatic condition that, when treated, may require frequent use of one or more medications that may cause side effects and have a substantial financial impact. When treatment is appropriate, an effective medication regimen requires attention to its effect on IOP, side effects, and the degree to which efficacy is reduced by nonadherence to therapy. The ophthalmologist should consider these issues in choosing a regimen of maximal effectiveness and tolerance to achieve the desired therapeutic response for each patient.[A:III] The diagnosis, number and severity of risk factors, prognosis and management plan, and likelihood of long-term therapy should be discussed with the patient.[A:III]

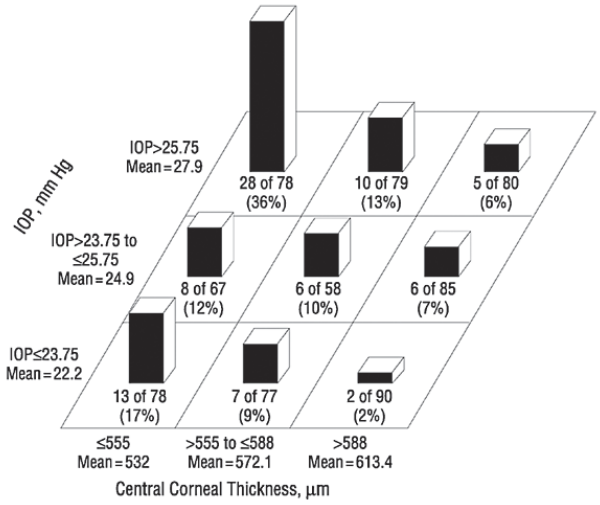

FIGURE 1. The percentage of participants in the observation group who developed primary open-angle glaucoma (median follow-up, 72 months) grouped by baseline intraocular pressure (IOP) of ≤23.75 mmHg, >23.75 mmHg to ≤25.75 mmHg, and >25.75 mmHg and by central thickness measurements of ≤555 µm, >555 µm to ≤588 µm, and >588 µm. These percentages are not adjusted for length of follow-up. The means are not identical to those given in the text, which includes all participants in the Ocular Hypertension Treatment Study rather than just the observation group.

SOURCE: Gordon MO, Beiser JA, Brandt JD, et al. The Ocular Hypertension Treatment Study: baseline factors that predict the onset of primary open-angle glaucoma. Arch Ophthalmol 2002; 120:714-20. Copyrighted © 2002. Reprinted with permission from the American Medical Association. All rights reserved.

Deciding When to Treat a Patient with Glaucoma Suspect

The decision to treat a glaucoma suspect patient may arise in various settings.

- Any patient who shows evidence of optic nerve deterioration based on optic nerve head appearance, retinal nerve fiber layer loss, or visual field changes consistent with glaucomatous damage has developed POAG and should be treated as described in the Primary Open-Angle Glaucoma PPP.[119] [A:III] Development of subtle abnormalities in the optic disc and retinal nerve fiber layer are best detected by comparing periodic fundus imaging with disc and retinal nerve fiber layer photography and computerized imaging of the optic nerve and nerve fiber layer.[81,120]
- A new visual field defect that is consistent with a pattern of glaucomatous visual field defect, confirmed on retesting of visual fields, may indicate that the patient has developed POAG.[110,121]
- A patient who demonstrates very high IOP in which optic nerve damage is likely to occur may require treatment.
- In some cases, initiating treatment to lower the risk of glaucomatous damage may be appropriate if the patient has risk factors for glaucoma, such as optic nerve appearance, that is very suspicious for glaucomatous damage, a strong family history of glaucoma, borderline visual field test findings, African American heritage, high myopia, or pseudoexfoliation (exfoliation syndrome).

  Whatever the scenario, a discussion must occur between the physician and patient to outline the risks and benefits of treatment versus nontreatment.

Target Intraocular Pressure

Patients who have evidence of POAG should be treated as in the Primary Open-Angle Glaucoma PPP. When deciding to treat a glaucoma suspect patient, the goal of treatment is to maintain the IOP in a range at which a patient is likely to remain stable.[7,122,123] The estimated upper limit of this range is considered the "target pressure." In glaucoma suspect patients for whom treatment has been chosen, target pressure can vary among patients, and in the same patient it may need adjustment

during the clinical course. In any patient, target pressure is an estimate and a means toward the ultimate goal of protecting the patient's vision. It is reasonable to begin by choosing a target pressure 20% lower than the mean of several baseline IOP measurements.[7] [A:I] Current IOP and its relationship to target IOP should be evaluated at each visit and individualized for each patient.[A:III]

In a patient who is a glaucoma suspect, a definite deterioration in optic nerve structure or visual field (i.e., conversion to glaucoma patient) suggests that the target pressure should be lower[96,124] [A:I] and the patient should be managed as described in the Primary Open-Angle Glaucoma PPP.[119] [A:III]

Therapeutic Choices

Unless contraindicated, medical therapy usually is the first intervention to lower IOP. There are many drugs available for initial therapy, and medication choice may be influenced by potential cost, side effects, and dosing schedules (see Table 1 for an overview of options available). Patient adherence to therapy is enhanced by using eye drops with the fewest side effects as infrequently as necessary to achieve the target IOP. If target IOP is not achieved by one medication, then additional separate medications, combination therapies, or switching of treatments may be considered to reach the target IOP.

Prostaglandin analogs and beta-adrenergic antagonists are the most frequently used initial eye drops for lowering IOP.[125,126] Prostaglandin analogs are the most effective drugs at lowering IOP and can be considered as initial medical therapy unless other considerations such as contraindications, cost, side effects, intolerance, or patient refusal preclude this.[127,128] [A:I] Other agents in addition to prostaglandin analogs and beta-adrenergic antagonists include $alpha_2$ adrenergic agonists, topical and oral carbonic anhydrase inhibitors, and parasympathomimetics.[129,130] But, because prostaglandins are very safe when used once daily and they have a high IOP-lowering effect, they are usually chosen as the first therapy for a patient with glaucoma suspect.

To determine the effectiveness of the chosen therapy, it may be useful to begin by treating only one eye and then comparing the relative change of the IOP in the two eyes at follow-up visits.[131] However, because the two eyes of an individual may not respond equally to the same medication, and because of the possibility of asymmetric spontaneous fluctuations and the potential for contralateral effect of monocular topical medications,[132] it is acceptable to compare the effect in one eye relative to multiple baseline measurements in the same eye.[133]

If a drug fails to reduce IOP sufficiently, then either switching to an alternative medication as monotherapy or adding additional medication is appropriate until the desired IOP level is attained.[109] [A:III] Since some studies have shown that adding a second medication decreased adherence to glaucoma treatment,[134,135] fixed combination therapy, while not recommended for initial treatment, may improve patient adherence.

The patient and the ophthalmologist together decide on a practical and feasible regimen to follow in terms of dosing, cost, and adherence in the context of the patient's age and preferences.[109] The ophthalmologist should assess the patient for local ocular and systemic side effects and toxicity, including interactions with other medications and potential life-threatening adverse reactions.[136] [A:III] To reduce systemic absorption after medication instillation, patients can be educated about eyelid closure or nasolacrimal occlusion (see Related Academy Materials section for patient education brochures).[137]

Adequate treatment to lower IOP requires a high level of adherence to therapy. Frequently, this is not achieved; studies indicate relatively poor adherence to therapy.[138-141] Even with instruction, free medication, once-daily administration, use of a dosing aid, and electronic monitoring of adherence, nearly 45% of patients with glaucoma in one study took fewer than 75% of their prescribed doses.[141] Repeated instruction and counseling in proper techniques for using medication as well as a clearly written medication regimen and follow-up telephone calls may improve adherence to therapy.[141-143] At each examination, medication dosage and frequency of use should be recorded.[A:III] Reviewing the time of day when medication was taken may be useful. Adherence to the therapeutic regimen and recommendations for therapeutic alternatives or diagnostic procedures should be discussed.[A:III] Cost may be a factor in adherence, especially when multiple medications are used.[143,144] Patient education and informed participation in treatment decisions may improve adherence[143] and overall effectiveness of management.

Laser trabeculoplasty may also benefit high-risk glaucoma suspect patients. If incisional surgery is to be considered, the patient can be managed as described in the Primary Open-Angle Glaucoma PPP.[119]

TABLE 1 GLAUCOMA MEDICATIONS

Drug Classification	Methods of Action	IOP Reduction*	Side Effects	Contraindications
Prostaglandin analogs	Increase uveoscleral and/or trabecular outflow	25%–33%	- Cystoid macular edema - Conjunctival injection - Increased eyelash growth - Periocular hyperpigmentation - Iris color change - Uveitis - Possible herpes virus activation	- Macular edema - History of herpetic keratitis
Beta-adrenergic antagonists (beta-blockers)	Decrease aqueous production	20%–25%	- Corneal toxicity - Allergic reactions - CHF (classic teaching, although cardiologists use beta-blockers as first line treatment in CHF) - Bronchospasm (seen with nonselective) - Bradycardia - Depression - Impotence	- Chronic obstructive pulmonary disease (nonselective) - Asthma (nonselective) - CHF (check with cardiologist) - Bradycardia - Hypotension - Greater than first degree heart block
Alpha-adrenergic agonists	Nonselective: improve aqueous outflow Selective: decrease aqueous production; decrease episcleral venous pressure or increase uveoscleral outflow	20%–25%	- Conjunctival injection - Allergic reactions - Fatigue - Somnolence - Headache	- Monoamine oxidase inhibitor therapy - Infants and children younger than 2 years
Parasympathomimetic agents	Increase trabecular outflow	20%–25%	- Increased myopia - Eye or brow ache/pain - Decreased vision - Cataract - Periocular contact dermatitis - Corneal toxicity - Paradoxical angle closure	- Neovascular, uveitic, or malignant glaucoma - Need to regularly assess fundus
Carbonic anhydrase inhibitors (mainly with systemic use)	Decrease aqueous production	15%–20%	With topical route: - Metallic taste - Allergic dermatitis/conjunctivitis - Corneal edema With oral route: - Stevens-Johnson syndrome - Malaise, anorexia, depression - Serum electrolyte imbalance - Renal calculi - Blood dyscrasias (aplastic anemia, thrombocytopenia) - Metallic taste	- Sulfonamide allergy - Kidney stones - Aplastic anemia - Thrombocytopenia - Sickle cell disease

CHF = congestive heart failure; IOP = intraocular pressure

* Data from the European Glaucoma Society. Terminology and Guidelines for Glaucoma. 3rd ed. Savona, Italy:Editrice Dogma S.r.l.; 2008:127. Available at: www.eugs.org/eng/EGS_guidelines.asp. Accessed May 28, 2010.

SOURCE: Adapted with permission from the American Academy of Ophthalmology Practicing Ophthalmologists Curriculum (POC) Panel Chairs and Vice Chairs. MOC Exam Study Kit. Core ophthalmic knowledge. Core topics for glaucoma: Medical management of glaucoma. Available to Academy members only at: http://one.aao.org/CE/MOC/MOCStudyResources.aspx. Accessed May 28, 2010.

FOLLOW-UP EVALUATION

The purpose of follow-up examination is to evaluate IOP level, visual field status, optic disc appearance, and retinal nerve fiber layer status to determine if damage has occurred. The interaction between patient and disease is unique for every patient, and management for each patient must always be individualized.[A:III]

History

The following interval history should be elicited during all follow-up visits for POAG suspect patients:

- Interval ocular history[A:III]
- Interval systemic medical and medication history[B:III]
- Side effects of ocular medications if the patient is being treated[A:III]
- Frequency and time of last IOP-lowering medications and review of medication use if the patient is being treated[B:III]

Ophthalmic Examination

The following components of the ophthalmic examination should be performed during all follow-up visits for POAG suspect patients:

- Visual acuity measurement[A:III]
- Slit-lamp biomicroscopy[A:III]
- Intraocular pressure measurement[A:I]

The frequency of periodic optic nerve head evaluation and documentation[116,145-147] and visual field evaluation[148-150] is based on risk assessment. Patients with thinner corneas,[7,8] higher IOPs,[7,8,11-20] disc hemorrhage,[25-29,151] larger cup-to-disc, larger mean PSD, or family history of glaucoma may warrant closer follow-up than patients with lower IOPs, normal corneal thickness, and no disc hemorrhages. Gonioscopy is indicated when there is a suspicion of an angle-closure component, anterior chamber shallowing, anterior chamber angle abnormalities, or if there is an unexplained change in IOP.[A:III] Gonioscopy should be performed periodically (i.e., 1 to 5 years).[A:III]

Adjustment of Therapy

The indications for adjusting therapy are as follows:[A:III]

- Target IOP is not achieved and the benefits of a change in therapy outweigh the risks for the patient
- Intraocular pressure is consistently below target, or visual field and optic discs remain stable for years. In this situation, a carefully monitored attempt to reduce the medical regimen is appropriate.
- Patient is intolerant of the prescribed medical regimen
- Patient does not adhere to the prescribed medical regimen because of cost or compliance issues
- Contraindications to individual medicines develop

PROVIDER AND SETTING

The performance of certain diagnostic procedures (e.g., tonometry, pachymetry, perimetry, fundus imaging and photography) may be delegated to appropriately trained and supervised personnel. However, the interpretations of results and the medical and surgical management of disease require the medical training, clinical judgment, and the experience of an ophthalmologist.

COUNSELING/REFERRAL

It is important to educate and engage patients in the management of their condition. This may be especially true for patients with open-angle glaucoma suspect, since some authors have shown that follow-up is poor in patients with this diagnosis.[152,153] One reason for this was patients' perception that their disease was "not serious enough."[152] Patients should be educated about their condition and its potential to lead to the blinding disease glaucoma, the rationale and goals of intervention, the status of their condition, and the relative benefits and risks of alternative interventions so that they

can participate meaningfully in developing an appropriate plan of action.[A:III] Patients should be encouraged to alert their ophthalmologists to physical or emotional changes that occur when taking glaucoma medications, if prescribed.[A:III] Glaucoma suspect diagnosis and treatments frequently affect patients' quality of life, including employment issues (e.g., fear of loss of job and insurance from diminished ability to read and drive), social issues (e.g., fear of negative impact on relationships and sexuality), and loss of independence and activities that require good visual acuity (e.g., sports and other hobbies). The ophthalmologist should be sensitive to these problems and provide support and encouragement.[A:III]

APPENDIX 1. QUALITY OF OPHTHALMIC CARE CORE CRITERIA

Providing quality care
is the physician's foremost ethical obligation, and is
the basis of public trust in physicians.
AMA Board of Trustees, 1986

Quality ophthalmic care is provided in a manner and with the skill that is consistent with the best interests of the patient. The discussion that follows characterizes the core elements of such care.

The ophthalmologist is first and foremost a physician. As such, the ophthalmologist demonstrates compassion and concern for the individual, and utilizes the science and art of medicine to help alleviate patient fear and suffering. The ophthalmologist strives to develop and maintain clinical skills at the highest feasible level, consistent with the needs of patients, through training and continuing education. The ophthalmologist evaluates those skills and medical knowledge in relation to the needs of the patient and responds accordingly. The ophthalmologist also ensures that needy patients receive necessary care directly or through referral to appropriate persons and facilities that will provide such care, and he or she supports activities that promote health and prevent disease and disability.

The ophthalmologist recognizes that disease places patients in a disadvantaged, dependent state. The ophthalmologist respects the dignity and integrity of his or her patients, and does not exploit their vulnerability.

Quality ophthalmic care has the following optimal attributes, among others.

- The essence of quality care is a meaningful partnership relationship between patient and physician. The ophthalmologist strives to communicate effectively with his or her patients, listening carefully to their needs and concerns. In turn, the ophthalmologist educates his or her patients about the nature and prognosis of their condition and about proper and appropriate therapeutic modalities. This is to ensure their meaningful participation (appropriate to their unique physical, intellectual and emotional state) in decisions affecting their management and care, to improve their motivation and compliance with the agreed plan of treatment, and to help alleviate their fears and concerns.
- The ophthalmologist uses his or her best judgment in choosing and timing appropriate diagnostic and therapeutic modalities as well as the frequency of evaluation and follow-up, with due regard to the urgency and nature of the patient's condition and unique needs and desires.
- The ophthalmologist carries out only those procedures for which he or she is adequately trained, experienced and competent, or, when necessary, is assisted by someone who is, depending on the urgency of the problem and availability and accessibility of alternative providers.
- Patients are assured access to, and continuity of, needed and appropriate ophthalmic care, which can be described as follows.
  - The ophthalmologist treats patients with due regard to timeliness, appropriateness, and his or her own ability to provide such care.

- The operating ophthalmologist makes adequate provision for appropriate pre- and postoperative patient care.
- When the ophthalmologist is unavailable for his or her patient, he or she provides appropriate alternate ophthalmic care, with adequate mechanisms for informing patients of the existence of such care and procedures for obtaining it.
- The ophthalmologist refers patients to other ophthalmologists and eye care providers based on the timeliness and appropriateness of such referral, the patient's needs, the competence and qualifications of the person to whom the referral is made, and access and availability.
- The ophthalmologist seeks appropriate consultation with due regard to the nature of the ocular or other medical or surgical problem. Consultants are suggested for their skill, competence, and accessibility. They receive as complete and accurate an accounting of the problem as necessary to provide efficient and effective advice or intervention, and in turn respond in an adequate and timely manner.
- The ophthalmologist maintains complete and accurate medical records.
- On appropriate request, the ophthalmologist provides a full and accurate rendering of the patient's records in his or her possession.
- The ophthalmologist reviews the results of consultations and laboratory tests in a timely and effective manner and takes appropriate actions.
- The ophthalmologist and those who assist in providing care identify themselves and their profession.
- For patients whose conditions fail to respond to treatment and for whom further treatment is unavailable, the ophthalmologist provides proper professional support, counseling, rehabilitative and social services, and referral as appropriate and accessible.

- Prior to therapeutic or invasive diagnostic procedures, the ophthalmologist becomes appropriately conversant with the patient's condition by collecting pertinent historical information and performing relevant preoperative examinations. Additionally, he or she enables the patient to reach a fully informed decision by providing an accurate and truthful explanation of the diagnosis; the nature, purpose, risks, benefits, and probability of success of the proposed treatment and of alternative treatment; and the risks and benefits of no treatment.
- The ophthalmologist adopts new technology (e.g., drugs, devices, surgical techniques) in judicious fashion, appropriate to the cost and potential benefit relative to existing alternatives and to its demonstrated safety and efficacy.
- The ophthalmologist enhances the quality of care he or she provides by periodically reviewing and assessing his or her personal performance in relation to established standards, and by revising or altering his or her practices and techniques appropriately.
- The ophthalmologist improves ophthalmic care by communicating to colleagues, through appropriate professional channels, knowledge gained through clinical research and practice. This includes alerting colleagues of instances of unusual or unexpected rates of complications and problems related to new drugs, devices or procedures.
- The ophthalmologist provides care in suitably staffed and equipped facilities adequate to deal with potential ocular and systemic complications requiring immediate attention.
- The ophthalmologist also provides ophthalmic care in a manner that is cost effective without unacceptably compromising accepted standards of quality.

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APPENDIX 2. MAJOR RECOMMENDATIONS FOR CARE

DIAGNOSIS

The comprehensive initial glaucoma suspect evaluation (history and physical examination) includes all components of the comprehensive adult medical eye evaluation[51] in addition to and with special attention to those factors that specifically bear upon the diagnosis, course, and treatment of POAG.

Evaluation of Visual Function

Self-reported functional status or difficulty with vision can be assessed either by patient complaints or by specific questionnaires including the National Eye Institute - Visual Function Questionnaire-25.[52-56] [A:III]

Ophthalmic Evaluation

History

- Ocular,[A:III] family,[15,57,58] [A:II] and systemic history (e.g., asthma, migraine headache, vasospasm).[A:III] The severity and outcome of glaucoma in family members, including history of visual loss from glaucoma, should be obtained during initial evaluation.[57,58] [B:III]
- Review of pertinent records[A:III] with particular reference to the IOP and the status of the optic nerve and visual field[A:III]
- Ocular and systemic medications (e.g., corticosteroids) and known local or systemic intolerance to ocular or systemic medications[A:III]
- Ocular surgery[A:III]

Visual acuity measurement

Visual acuity with current correction (the power of the present correction recorded) at distance and, when appropriate, at near should be measured.[A:III]

Pupil examination

The pupils are examined for reactivity and an afferent pupillary defect.[62-64] [B:II]

Anterior segment examination

A slit-lamp biomicroscopic examination of the anterior segment can provide evidence of physical findings associated with narrow angles, such as shallow peripheral anterior chamber depth and crowded anterior chamber angle anatomy,[65,66] corneal pathology, or a secondary mechanism for elevated IOP such as pseudoexfoliation (exfoliation syndrome), pigment dispersion with iris transillumination defects, iris and angle neovascularization, or inflammation.[A:III]

Intraocular pressure measurement

Intraocular pressure is measured in each eye, preferably by Goldmann applanation tonometry, before gonioscopy or dilation of the pupil.[67] [A:III]

Gonioscopy

The diagnosis of POAG requires careful evaluation of the anterior chamber angle to exclude angle closure or secondary causes of IOP elevation, such as angle recession, pigment dispersion, peripheral anterior synechiae, angle neovascularization, and inflammatory precipitates.[78] [A:III]

Optic nerve head and retinal nerve fiber layer examination

The preferred technique for optic nerve head and retinal nerve fiber layer evaluation involves magnified stereoscopic visualization (as with the slit-lamp biomicroscope), preferably through a dilated pupil.[A:III]

Fundus examination

Examination of the fundus, through a dilated pupil whenever feasible, includes a search for other abnormalities that may account for optic nerve changes and/or visual field defects (e.g., optic nerve pallor, disc drusen, optic nerve pits, disc edema due to central nervous system disease, macular degeneration, retinal vascular occlusion, and other retinal disease).[A:III]

Supplemental Ophthalmic Testing

Central corneal thickness

Measurement of central corneal thickness (CCT) aids the interpretation of IOP readings and helps to stratify patient risk for optic nerve damage.[7,8,98-100 [A:II]]

Visual field evaluation

Automated static threshold perimetry is the preferred technique for evaluating the visual field.[105 [A:III]] Careful manual combined kinetic and static threshold testing (e.g., Goldmann visual fields) is an acceptable alternative when patients cannot perform automated perimetry reliably or if it is not available.[A:III] Repeat, confirmatory visual field examinations may be required for test results that are unreliable or show a new glaucomatous defect before changing management.[110,111 [A:III]]

Optic nerve head and retinal nerve fiber layer analysis

The appearance of the optic nerve should be documented.[83,109 [A:II]] Color stereophotography is an accepted method for documenting optic nerve head appearance. Computer-based image analysis of the optic nerve head and retinal nerve fiber layer is an alternative for documentation of the optic nerve and can identify patients at greater risk of progression to glaucoma.[83,113] In the absence of these technologies, a nonstereoscopic photograph or a drawing of the optic nerve head should be recorded, but these are less desirable alternatives to stereophotography or computer-based imaging.[116 [A:III]]

Management recommendations are described in the main body of the text.

FOLLOW-UP EVALUATION

History

The following interval history should be elicited during all follow-up visits for POAG suspect patients:

- Interval ocular history[A:III]
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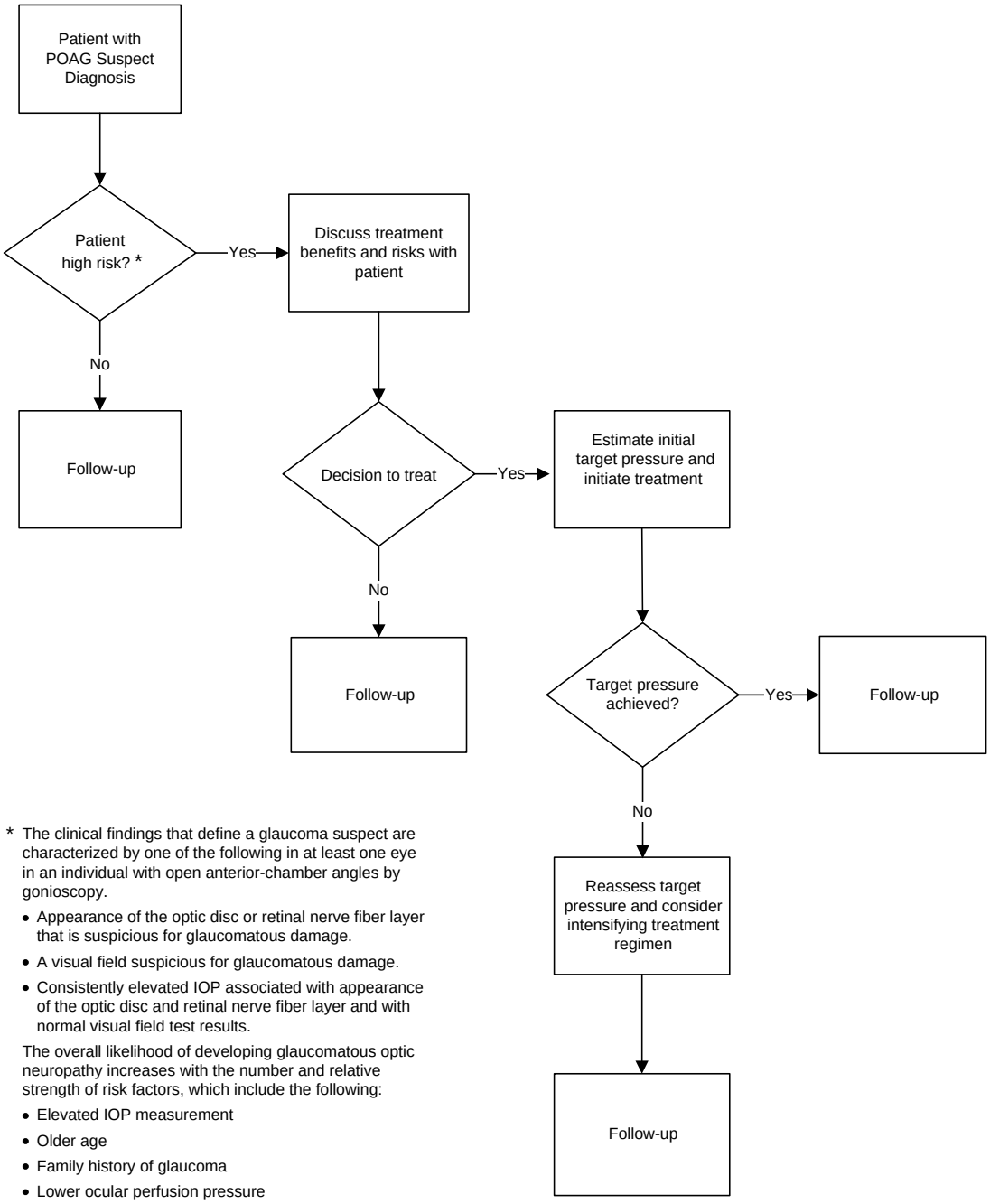
COUNSELING/REFERRAL

Patients should be educated about their condition and its potential to lead to the blinding disease glaucoma, the rationale and goals of intervention, the status of their condition, and the relative benefits and risks of alternative interventions so that they can participate meaningfully in developing an appropriate plan of action.[A:III] Patients should be encouraged to alert their ophthalmologists to physical or emotional changes that occur when taking glaucoma medications, if prescribed.[A:III] The ophthalmologist should be sensitive to these problems and provide support and encouragement.[A:III]

APPENDIX 3. MANAGEMENT ALGORITHM FOR PATIENTS WITH PRIMARY OPEN-ANGLE GLAUCOMA (POAG) SUSPECT



* The clinical findings that define a glaucoma suspect are characterized by one of the following in at least one eye in an individual with open anterior-chamber angles by gonioscopy.

- Appearance of the optic disc or retinal nerve fiber layer that is suspicious for glaucomatous damage.
- A visual field suspicious for glaucomatous damage.
- Consistently elevated IOP associated with appearance of the optic disc and retinal nerve fiber layer and with normal visual field test results.

The overall likelihood of developing glaucomatous optic neuropathy increases with the number and relative strength of risk factors, which include the following:

- Elevated IOP measurement
- Older age
- Family history of glaucoma
- Lower ocular perfusion pressure
- Lower systolic blood pressure
- Thinner central corneal thickness
- Disc hemorrhage
- Increased cup-to-disc ratio
- Larger mean pattern standard deviation on threshold visual field testing

APPENDIX 4. INTERNATIONAL STATISTICAL CLASSIFICATION OF DISEASES AND RELATED HEALTH PROBLEMS (ICD-9) CODES

The POAG Suspect PPP covers the entity of primary open-angle suspect, or borderline glaucoma, (ICD-9 #365.0) and related entities with the following ICD-9 classifications:

- Preglaucoma, unspecified (365.00)
- Open angle with borderline findings (e.g., borderline intraocular pressure [IOP] or optic disc appearance suspicious of glaucoma) (365.01)
- Steroid responders (365.03)
- Ocular hypertension (365.04)

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Glaucoma brochure (2010) (Spanish: Entendiendo el Glaucoma [2010])

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Glaucoma (Series 4, 2007)

To order any of these materials, please call the Academy's Customer Service number, 866.561.8558 (U.S. only) or 415.561.8540 or visit www.aao.org/store.

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P.O. Box 7424
San Francisco,
California 94120-7424
415.561.8500