Prevalence of angle closure disease in an ophthalmology teaching hospital before and after encouragement of gonioscopy

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Abstract

**Purpose:** To compare the prevalence of angle closure disease (ACD) diagnoses in a glaucoma department of an ophthalmology teaching hospital at two cut points, before and after encouragement of a supervised, mandatory gonioscopy for all patients, during all visits as well as to profile patients with angle closure disease in terms of age, gender, intraocular pressure, visual acuity, cup-to-disc ratio and refractive error parameters when divided by Foster's classification.

**Study design:** Retrospective, two cut-point observational study.

**Material and methods:** A 1-month sample of electronic medical records from 2010 and from 2013 was analyzed. Between those two cut points, gonioscopy was encouraged as a mandatory procedure and execution was supervised systematically. The prevalence of angle closure disease was obtained from the diagnosis of electronic medical records and patients with ACD were divided according to Foster's ACD classification in order to profile them.

**Results:** A total of 2112 medical records from 2010 and 2549 medical records from 2013 were included. Angle closure disease prevalence went from 7.29% (n=154) in 2010 to 20.36% (n=519) in 2013. Prevalence of primary open angle glaucoma (POAG) decreased from 23.20% to 10.84% in the same time period.

**Conclusions:** A comparison between the prevalence of angle closure disease between these two cut points showed a considerable increase. Angle closure disease was diagnosed 1.79 times more as opposed to when gonioscopy was not previously encouraged or supervised. ACD patients are generally women, with decreasing low hyperopia and intraocular pressure within normal ranges.

**Keywords:** gonioscopy; angle closure disease; glaucoma; teaching glaucoma

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Introduction

Gonioscopy is a useful diagnostic tool for ophthalmic diseases related to the iridocorneal angle. It particularly helps to determine causes of elevated intraocular pressure and/or glaucomatous optic neuropathy. In spite of its importance, it is not always part of a routine ophthalmologic examination, even when performed by glaucoma experts or in glaucoma subspecialty clinics. Although it is infrequently performed, when carried out it becomes subject to an inadequate technique and subsequently, a poor consensus of results among observers.

An adequate gonioscopy should include topical anesthesia, a good elbow support for the examiner, good control over the pressure force applied to the lens, a complete explanation of the process for the patient and correct head alignment. Additionally, it is important to set a dim room illumination and to keep direct light away from the pupil. Iridocorneal anatomy should be well known and an adequate learning curve is essential in order to identify all structures in the trabecular meshwork. This is even more necessary when performing a dynamic gonioscopy (with and without indentation, with and without illumination, and with different types of examination lenses).

Angle closure disease (ACD) is a spectrum of diseases that comprise: primary angle closure suspect (PACS), primary angle closure (PAC) and angle closure glaucoma (ACG) according to Foster et al. This disease is classified as follows:

1. **Primary angle closure suspect:** An eye in which appositional contact between the peripheral iris and posterior trabecular meshwork is considered possible (when more than 180
degrees of the meshwork is not visible on an adequate gonioscopy.

2. Primary angle closure (PAC): An eye with an occludable drainage angle and features indicating that trabecular obstruction by the peripheral iris has occurred, such as peripheral anterior synechiae, elevated intraocular pressure, iris whorling (distortion of the radially orientated iris fibers), “glaucomfleken” lens opacities, or excessive pigment deposition on the trabecular surface. The optic disc does not have glaucomatous damage.

3. Angle closure glaucoma (ACG): PAC together with evidence of glaucoma, as defined above.

**Purpose**

1. To compare the prevalence of angle closure disease (ACD) diagnoses in a glaucoma department of an ophthalmology teaching hospital before and after encouragement of a supervised, mandatory gonioscopy for all patients, during all visits.

2. To profile patients with angle closure disease in terms of age, gender, intraocular pressure, visual acuity, cup-to-disc ratio and refractive parameters when divided by Foster's classification in this clinic-based, heterogeneous Latin American population.

**Material and methods**

Electronic medical records from 2010 and also from 2013 at the glaucoma department at our institution were retrieved. Only one month of the year was sampled (July 2010 and July 2013), in order to avoid experience related issues from glaucoma fellows at the beginning of the academic year (March) since supervision requires a good learning curve from the supervisor. Besides, retrieval by month is practical in our electronic medical records and a difference in distribution of diagnoses by season has not been reported. In-between those years, our institution implemented strategies, directed at improving glaucoma examination, including mandatory and supervised gonioscopy for all patients during all visits, and also gonioscopy teaching workshops for all ophthalmology residents. During this period, it was established that gonioscopy should be performed with adequate elbow support, a goniolens that enables indentation and emphasis on the use of a slit light that avoids the pupil. Second and third year ophthalmology residents working at the glaucoma department at the time, were obliged to introduce all patients to the glaucoma fellow, and if any doubt or second opinion was needed, the patient was also evaluated by the glaucoma assistant professor.

The prevalence of ACD was obtained from the diagnoses of electronic medical records. Characterization of patients with general ACD was performed and then divided according to Foster’s ACD classification: primary angle closure suspect (PACS), primary angle closure (PAC) and angle closure glaucoma (ACG). Data obtained included age, diagnosis, visual acuity and intraocular pressure. For patients with angle closure disease in 2013, visual capacity, sphere, cylinder, spherical equivalent, cup-to-disc ratio and number of glaucoma medications were analyzed.

Data was analyzed obtaining means, ratios, standard deviation and ranges using Microsoft Excel 2010. We used an unpaired t-test in order to compare means between PACS vs PAC, PAC vs ACG, and PACS vs ACG. A p of less than 0.05 was considered as statistically significant. We calculated odds ratio for gender using MedCalc (medcalc.org).

**Results**

A total of 2112 medical records from 2010 and 2549 medical records from 2013 were included.

Angle closure disease prevalence went from 7.29% (n=154) in 2010 to 20.36% (n=519) in 2013.

Prevalence of primary open angle glaucoma (POAG) decreased from 23.20% to 10.84% in the same time period.

Table 1. Common Diagnoses at the Glaucoma Department 2010 vs 2013

<table>
<thead>
<tr>
<th>DIAGNOSIS</th>
<th>2010</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>POAG</td>
<td>23.20%</td>
<td>10.84%</td>
</tr>
<tr>
<td>ACD (including ACG)</td>
<td>7.29%</td>
<td>20.36%</td>
</tr>
<tr>
<td>ACG</td>
<td>6.60%</td>
<td>15.30%</td>
</tr>
<tr>
<td>NVG</td>
<td>5.30%</td>
<td>4.30%</td>
</tr>
</tbody>
</table>

Table 1. shows the most common diagnoses and their distributions in 2010 and 2013.

POAG: Primary Open Angle Glaucoma; ACD: Angle Closure Disease; ACG: Angle Closure Glaucoma; NVG: Neovascular Glaucoma. Angle closure disease (ACD) includes all stages of PACS, PAC and ACG.

Angle closure disease characterization revealed that women are the most affected, representing 83.26% of the population with angle closure and showing an odds ratio of 3.31 (CI95% 2.58 to 4.23; p<0.001).

Spherical equivalent is also different in all stages varying from +0.63 to +0.50 and +0.16 in PACS, PAC and ACG respectively. Spheres alone vary from +1.00 in PACS vs +0.60 in ACG.
Discussion

Angle closure disease prevalence varies significantly in published data and moreover, it reports that different mechanisms are involved depending on ethnic origin. But it is certainly a more blinding disease than primary open angle glaucoma.

At the authors’ glaucoma department, an increment in the diagnosis of angle closure disease was empirically observed in the last couple of years (2013-2016). Gonioscopy workshops, mandatory and supervised gonioscopy by a glaucoma fellow or assistant professor, and grouping of patients according to their type of glaucoma were strategies that preceded this observation. These events also led to an increase in the number of procedures which aim for angle aperture: Nd:YAG iridotomies, argon iridoplasty and phacoemulsification. This supposed increase in prevalence also brought an increase in the number of diagnostic tests designed to measure ocular biometry related to the angle including: A scan echography, ultra-biomicroscopy and anterior segment optical coherence tomography. Thus, the authors wanted to compare the prevalence of angle closure disease before and after these strategies were implemented and to characterize patients with the disease at their teaching hospital.

It is presumed that this shift in prevalence between the two samples may be due to an increase in awareness of the disease in the past couple of years and the strategies established at the authors’ institution. Such an increase is more likely to be based on these assumptions, and not on a change in the type of population, given that the samples from 2010

### Table 2. Characterization of ACD patients and according to Foster Natural History Classification with mean comparison

<table>
<thead>
<tr>
<th>General</th>
<th>Foster Classification</th>
<th>Mean comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACD Angle closure disease</td>
<td>PACS</td>
<td>PAC</td>
</tr>
<tr>
<td>(n=519)</td>
<td>(n=91)</td>
<td>(n=38)</td>
</tr>
<tr>
<td>PREVALENCE</td>
<td>20.36%</td>
<td>3.57%</td>
</tr>
<tr>
<td>AGE (YEARS)</td>
<td>70.69 SD 10.08 range</td>
<td>67 SD 9.6 range</td>
</tr>
<tr>
<td></td>
<td>34-94</td>
<td>42-89</td>
</tr>
<tr>
<td>GENDER (% FEMALE)</td>
<td>83.26%</td>
<td>82.41%</td>
</tr>
<tr>
<td>IOP (mmHg)</td>
<td>16.28 SD 5.34 range</td>
<td>16.42 SD 3.18</td>
</tr>
<tr>
<td></td>
<td>8 to 56</td>
<td>from 8 to 25</td>
</tr>
<tr>
<td>BCVA (log MAR)</td>
<td>0.27 SD 0.55 range</td>
<td>0.13 SD 0.31</td>
</tr>
<tr>
<td></td>
<td>from 0 to 3</td>
<td>from 0 to 3</td>
</tr>
<tr>
<td>SPHERE (+ DIOPTERS)</td>
<td>0.73 SD 1.70 range</td>
<td>1.04 SD 1.30</td>
</tr>
<tr>
<td></td>
<td>from -8.8 to 13.5</td>
<td>from -3.0 to 4.3</td>
</tr>
<tr>
<td>SPHERICAL EQUVALENT (+ Diopters)</td>
<td>0.27 SD 1.84 range</td>
<td>0.63 SD 1.30</td>
</tr>
<tr>
<td></td>
<td>-24.0 to 13.9</td>
<td>from -4.3 to 4.1</td>
</tr>
<tr>
<td>NUMBER OF MEDICATIONS</td>
<td>1.45 SD 1.08 range</td>
<td>0.63 SD 0.77</td>
</tr>
<tr>
<td></td>
<td>from 0 to 4</td>
<td>from 0 to 4</td>
</tr>
<tr>
<td>CUP-TO-DISC RATIO</td>
<td>0.70 SD 0.19 range</td>
<td>0.53 SD 0.17</td>
</tr>
<tr>
<td></td>
<td>from 0 to 1</td>
<td>from 0 to 1</td>
</tr>
</tbody>
</table>

Table 2. shows results for means, standard deviation, range and p between each stage.
and 2013 did not vary significantly in age, gender and other types of diagnoses.

Characterization of the patients in 2013 showed that ACD patients are generally women, with decreasing low hyperopia, office intraocular pressure measurements within normal ranges (16.28 mmHg ± 5.34). Other characteristics vary as expected among the different stages of disease: age, cup-to-disc ratio and number of medications.

Different age means were noticed at the different stages of angle closure disease, which suggests that progression through the stages of ACD is strongly related to a natural history. Absence of statistical significance between nearby stages but not between separate stages suggests that angle closure is a continuum. Spherical equivalent differences along the disease stages suggest that the myopic-shift phenomenon mostly due to lens thickening manifests in these patients as an "emmetropic-shift phenomenon".

Further studies are needed to confirm this prevalence prospectively, because this is the first time that a high prevalence of angle closure in our population has been reported. Gilbert, in a previous survey-based, multicentric study reported a much lower prevalence has been reported. Gilbert-Lucido ME, García-Huerta M, Ruiz-Quintero MK, Tse RK. Visualization of anterior chamber angle dynamics using optical coherence tomography. Ophthalmology. 2005;112(6): 980-4.

Additional data suggests that a similar shift in diagnosis is occurring worldwide as angle closure awareness increases, which in turn, decreases the frequency of acute angle closure due to prompt treatment. However, an increase in awareness may imply over-diagnosis. This is an issue that future papers with a prospective methodology must address. If possible, they should also include ancillary studies to determine causes of angle closure in order to divide patients both into a primary and secondary angle closure classification. There are some unpublished studies at our institution that suggest that the mechanism in our population could be caused by a mixture of elements: ciliary body, lens (thickness and position), and choroid/iris (volume and dynamics).

Conclusion

A comparison of the prevalence of angle closure disease between 2010 and 2013 showed a considerable increment, probably in association with the establishment of mandatory, standardized and supervised gonioscopy for all patients during all visits in a glaucoma department of an ophthalmology teaching hospital. Angle closure disease was diagnosed 1.79 times more as opposed to when it was not previously mandatory or supervised.

Characterization showed that ACD patients are generally women, with decreasing low hyperopia, office intraocular pressure measurements within normal ranges, and variable characteristics according to the stage of the disease.

References

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