Société Française d'Ophtalmologie

Société Française du Glaucome
Comité de Lutte contre le Glaucome

Detection and management of the risk of angle-closure glaucoma

Written with the assistance of Esther Blumen, Emmanuelle Brasnu, Yves Lachkar, Xavier Zanlonghi

Glaucoma is an optic neuropathy causing a progressive damage of the optic nerve fibers forming the optic nerve. It may be a primary neuropathy, *i.e.* without known etiological cause, or secondary to an anomaly promoting its occurrence. Angle-closure glaucoma (ACG) occurs as a result of an anatomical anomaly with closure of the iridocorneal angle (ICA), impeding the functioning of the trabecular meshwork.

1. CONTEXT:

ACG is a relatively common entity, often undiagnosed, source of misdiagnosis and inadequate management: investigating its presence in any patient with confirmed or suspected glaucoma is the only way to identify the *primum movens*, i.e. the angle closure, and to propose an adapted treatment plan. Gonioscopy, the physical examination of the ICA, still remains essential for the diagnosis of angle closure: it is obviously insufficiently performed in everyday clinical practice [1].

2. EPIDEMIOLOGY:

Primary angle-closure glaucoma (PACG) is a global public health issue. In 2010, it represented 26% of all glaucoma, and will likely represent a similar proportion in 2020 with 21 million patients with PACG according to the forecasts of H. Quigley [2]. The spectrum of blindness is even more alarming, affecting 5.3 million patients with PACG i.e. 1 out of 4 patients, versus 1 out of 10 patients in the group of patients with primary open-angle glaucoma (POAG).

A disabling visual functional impairment is found in 1 out of 4 patients with PACG and in 1 out of 10 patients with POAG. PACG is responsible for half of cases of blindness due to glaucoma.

3. DEFINITIONS:

ACG is the result of an anatomical situation impairing the trabecular flow of aqueous humor. A clinical continuum has been described, in particular by Foster [3], establishing a link between the closure of the ICA and the occurrence of glaucomatous optic neuropathy.

ACG classification has evolved and the terminology identifies different concepts depending on the stages from the history of angle closure. It is important to note that the term "glaucoma" is now only used when a progressive optic neuropathy is present. Thus, the former "acute angle-closure glaucoma" is now called "acute angle-closure attack" since the acute attack causes no progressive neuropathy with increase in cup/disc ratio [3].
Thus, the risk of angle-closure glaucoma should include the risk of acute attack and the risk of developing progressive optic neuropathy whose symptoms are similar to those of chronic open-angle glaucoma if gonioscopy is not performed (i.e. asymptomatic glaucoma with painless white eye, reactive round pupil).

There are 3 stages:

a) Angle-closure suspect: possible iris apposition at the posterior trabecular meshwork, referred to as angle likely to close.
b) Primary closure of the ICA: ICA likely to close with clinical evidence of prior angle closures, such as peripheral anterior synechiae (PAS), ocular hypertonia, glaukomflecken, sectorial iris atrophy…
c) Primary angle-closure glaucoma (PACG): glaucomatous optic neuropathy occurring in a context of angle closure.

Angle likely to close: this situation is not unique but an angle is likely to close when the pigmented trabecular meshwork is not visible on primary gonioscopy on 270° or on three quarters of its circumference [4].

4. CONDUCT OF THE OPHTHALMOLOGIC EXAMINATION:

a. QUESTIONING:

The presence of risk factors for PACG will first be investigated:

- Family history
- Demographic factors: elderly, female gender, Asian descent
- Refractive factors: hyperopia
- Biometric factors: short axial length, shallow anterior chamber, significant lenticular volume.

This questioning will also allow investigating the presence of signs suggestive of subacute ICA closure attacks, headache, halos, eye pain, blurred vision, photophobia…

Finally, it will rule out other possible causes of secondary glaucoma: ocular trauma, prior corticosteroid therapy, previous eye surgery…

b. PHYSICAL EXAMINATION:

Besides optic disc examination to identify a suggestive glaucomatous damage, measurement of the intraocular pressure (IOP) and central corneal thickness, the biomicroscopic examination will analyze the anterior segment:

- the depth of the anterior chamber may be estimated in fine oblique slot. The Van Herick test relates the depth of the anterior chamber to the corneal thickness at the limbus, but does not exempt performing gonioscopy,

- the lenticular volume will be clinically assessed,

- the presence of a plateau iris may be suspected in some cases,

- the signs suggestive of prior unnoticed IAC closure attacks will be investigated: iris sphincter atrophy, relative mydriasis, glaukomflecken (whitish deposits on the anterior lens capsule)…

- the signs indicating a possible prior management, namely the presence of a peripheral iridotomy, an iridoplasty, an implant….

c. GONIOSCOPY:

Gonioscopy, which is the clinical analysis of the ICA, is the key examination for detecting angle closure. It is performed using a lens for indirect view of the angle structures. Different lenses are available for this examination, the lenses enabling dynamic gonioscopy such as Posner, have the advantage to be able to distinguish a simple iris apposition from an irreversible PAS. Indeed, dynamic gonioscopy is performed using a lens whose diameter is less than the corneal diameter; by applying an antero-posterior pressure on the cornea, the aqueous humor will be pushed in the periphery and this maneuver will re-open the ICA in case of iris apposition but not in case of synechia.

Gonioscopy should be performed in all patients with glaucoma or risk factors for glaucoma, including PACG. It will thus allow distinguishing various anatomical situations leading to specific and individualized managements.

Gonioscopy will help to identify a closure of the ICA, assess its extent, its (non-)reversible nature; it will also be used to analyze the potential underlying closure mechanisms. Indeed, the pupil block is the most common mechanism of angle closure, but it may be associated with an angle obstruction such as a plateau iris, a lenticular closure mechanism or even a retrolenticular mechanism [5]. It is then easy to understand the importance of this examination for an optimized management depending on the suspected closure mechanism.

d. PARACLINICAL EXAMINATIONS:

The glaucomatous damage will naturally be assessed through a conventional structural and functional analysis: it will thus be possible to propose an analysis of the retinal nerve fibers and ganglion cell complex by OCT and a functional analysis by adapted automated perimetry.

Examinations enabling anterior segment imaging have recently been developed; they mainly include ultrasound biomicroscopy (UBM) and OCT of the anterior segment. These examinations

sometimes provide valuable assistance to the analysis of ICA closure mechanisms, but are not currently essential or mandatory to make a positive diagnosis, for the differential diagnosis or for the etiological diagnosis. However in some cases, they allow ruling out secondary forms of angle closure (cysts or tumors) [6]. Further developments of these technologies, patient longitudinal monitoring and assessment through clinical studies, will help to better position these examinations in the diagnostic scheme of PACG.

There is currently no examination to replace gonioscopy in this specific context of angle closure assessment, and none of these examinations may replace gonioscopy for the choice of the anatomical management.

5. CLINICAL MONITORING:

Patients with PACG require a longitudinal monitoring to assess the progression rate of their glaucomatous neuropathy, and adjust IOP management depending on their target IOP. They will require an anatomical monitoring of their ICA depending on the proposed management: for example, the result of peripheral iridotomy will be verified after laser therapy and the reopening of the angle will be regularly reassessed during the monitoring, by performing iterative gonioscopy aiming at ruling out other potential mechanisms of angle closure.

An important point to emphasize is the need to consider any patient who experienced angle closure, as potentially at risk of developing glaucomatous neuropathy, even remotely from the closure attack. Indeed, an iris apposition, even ideally managed from its onset, may impair the functioning of the trabecular meshwork, leading to resistance to the aqueous humor outflow, ocular hypertonia, and glaucoma.

6. THERAPEUTIC MANAGEMENT:

The management of the risk of PACG is highly variable depending on the situations and is not yet the subject of a consensus. In particular, it depends on the primary or secondary nature of the angle closure, the pathophysiological mechanism involved, and the stage of closure.

a. ANGLE-CLOSURE SUSPECT[7, 8]:

The management of angle-closure suspect should be **assessed on a case-by-case basis after a thorough examination by dynamic gonioscopy**.

Before deciding to treat or not, the ophthalmologist should, by analyzing the gonioscopic aspect, assess the benefits and risks of laser peripheral iridotomy (PI) which, although rapid and relatively well tolerated, may cause complications such as raised IOP, endothelial decompensation, intraocular inflammation, hyphema, formation of anterior or posterior synechiae, occurrence of cataract...

In practice, as suggested by the latest recommendations of the European Glaucoma Society [8], laser PI may be proposed in patients with narrow ICA with irido-trabecular contact on 2 quadrants or more, in the absence of PAS. This procedure may be coupled with argon laser iridoplasty performed as a second step if a plateau iris configuration is present with persistence of an angle closure despite performing transfixing PI.

Laser PI may also be proposed in cases of primary ICA closure of the contralateral eye.

The other indications shall be assessed on a case-by-case basis by the ophthalmologist, since performing isolated laser PI is not recommended when extended PAS are present.

b. PRIMARY CLOSURE OF THE ICA AND PACG:

There is currently **no consensus on the preferred therapeutic procedure in patients with primary angle closure or chronic glaucoma due to primary ICA closure.** Nevertheless, when faced with these two clinical pictures, a single medical treatment should be avoided, since **the suppression of the pupil block is mandatory** [8].

Laser PI (or surgical iridectomy) will thus be proposed in the absence of PAS extended on more than 2 quadrants.

Phakoexeresis is another possible alternative at all stages, which is used to achieve a deepening of the anterior chamber, a reopening of the ICA (in the absence of PAS), and often a lowering in IOP [9]. For some ophthalmologists, it may be an alternative to iridotomy or trabeculectomy in eyes with primary acute or chronic angle closure [10-12].

However, if the IOP is not medically controlled despite the suppression of the pupil block (with or without phakoexeresis), perforating trabeculectomy may be proposed while taking into account the risk of malignant glaucoma.

c. ACUTE ICA CLOSURE ATTACK

Several options may be proposed for the management of acute ICA closure attack [8]. Laser PI (or surgical iridectomy) associated with a medical treatment is the preferred treatment to patients with acute angle closure due to pupil block.

- Medical treatment:
    - Local: hypotensive drugs (beta blockers, alpha-agonists), myotic agents (pilocarpine 2%) and anti-inflammatory eye drops (corticosteroids).
    - Systemic (*per os* or IV): acetazolamide and/or mannitol
- Laser peripheral iridotomy
- Argon laser iridoplasty
- Phakoexeresis
- Trabeculectomy
- Paracentesis
- Goniosynechialysis

In patients with acute ICA closure with plateau iris configuration, laser PI is proposed before performing argon laser iridoplasty, to first rule out a possible pupil block component.

7. CONCLUSIONS:

PACG is common and potentially devastating. It results from an anatomical anomaly impeding the normal flow of fluids in the anterior segment. Gonioscopy is the screening key examination. Its management is based on the solution of the initial anatomical problem. The relevant treatments proposed, in particular laser therapy, are more successful at the early stage of the disease.

8. REFERENCES:

1. Fremont, A.M., et al., *Patterns of care for open-angle glaucoma in managed care.* Arch Ophthalmol, 2003. **121**(6): p. 777-83.
2. Quigley, H.A., A.T. Broman, *The number of people with glaucoma worldwide in 2010 and 2020.* Br J Ophthalmol, 2006. **90**(3): p. 262-7.
3. Foster, P.J., et al., *The definition and classification of glaucoma in prevalence surveys.* Br J Ophthalmol, 2002. **86**(2): p. 238-42.
4. Foster, P.J., et al., *Defining "occludable" angles in population surveys: drainage angle width, peripheral anterior synechiae, and glaucomatous optic neuropathy in east Asian people.* Br J Ophthalmol, 2004. **88**(4): p. 486-90.
5. Ritch R, L.R., *Ritch R, Shields MB, Krupin T. The Glaucomas. 2nd ed.*, in *The Glaucomas. 2nd ed.* , S.l. Mosby, Editor. 1996. p. 801.
6. Smith, S.D., et al., *Evaluation of the anterior chamber angle in glaucoma: a report by the american academy of ophthalmology.* Ophthalmology, 2013. **120**(10): p. 1985-97.
7. Emanuel, M.E., R.K. Parrish, 2nd, S.J. Gedde, *Evidence-based management of primary angle closure glaucoma.* Curr Opin Ophthalmol, 2014. **25**(2): p. 89-92.
8. European Glaucoma Society, *Terminology and guidelines for glaucoma. 4th Edition.*, ed. DOGMA. 2014, Savona, Italy.
9. Huang, G., et al., *Anterior chamber depth, iridocorneal angle width, and intraocular pressure changes after phacoemulsification: narrow vs open iridocorneal angles.* Arch Ophthalmol, 2011. **129**(10): p. 1283-90.
10. Leung, C.K., et al., *Anterior chamber angle measurement with anterior segment optical coherence tomography: a comparison between slit lamp OCT and Visante OCT.* Invest Ophthalmol Vis Sci, 2008. **49**(8): p. 3469-74.
11. Tham, C.C., et al., *Phacoemulsification versus trabeculectomy in medically uncontrolled chronic angle-closure glaucoma without cataract.* Ophthalmology, 2013. **120**(1): p. 62-7.
12. Barbosa, D.T., A.L. Levison, S.C. Lin, *Clear lens extraction in angle-closure glaucoma patients.* Int J Ophthalmol, 2013. **6**(3): p. 406-8.