CASE REPORT

Case Report: The efficacy of early phacoemulsification in the intraocular pressure control in primary angle closure glaucoma associated with cataract in a young female [version 1; peer review: 1 approved, 1 approved with reservations]

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Abstract
Glaucoma is a leading cause of irreversible blindness in the world, second only to cataract. Among different types of glaucoma, irreversible bilateral visual impairment is more common in primary angle closure glaucoma (PACG) patients. PACG and cataract often coexist and are both more prevalent among the elderly population, being rare in children and young adults.
Here, we discuss the case of a 39-year-old Caucasian woman with unilateral PACG associated with cataract. The patient presented with a several-day history of left sided headache, decreased and blurred vision as well as pain and redness of the left eye (LE). She reported similar episodes in the previous year. Visual acuity (VA) of the LE was limited to counting fingers and intra-ocular pressure (IOP) of the LE was 42 mmHg. Anterior segment examination of the LE revealed: edematous cornea, a peripheral anterior chamber depth corresponding to Van Herick's grade 0, mid-dilated pupil and lens opacities with visible glaukomflecken. Gonioscopic evaluation revealed iridotrabecular contact for 360°, no visible angle structures and a flat-mild convex iris contour. The digital image of the optic disc suggested only a thinning of neuro-retinal rim at the lower pole.
Following treatment of the initial symptoms, phacoemulsification with intra-ocular lens implant was performed. IOP improved and no IOP-lowering medication was required. The patient was monitored for VA, IOP, field of vision changes, and optic disc evaluation every six months for 2 years and no glaucomatous change occurred. The patient also denied ocular symptoms during this period.
This case supports the effectiveness of early phacoemulsification in the IOP control in patients with PACG.
**Keywords**
primary angle closure glaucoma, cataract, phacoemulsification

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Introduction
Glaucoma is the second leading cause of blindness around the world, being prevalent in 3.5% in those 40 years and older. The number of people with glaucoma worldwide is expected to rise from 64 million to 76 million in 2020 and to 111 million by 2040, with Africa and Asia being affected more heavily than the rest of the world. This disease is generally determined by damage to the optic nerve level as a result of abnormally high intraocular pressure.

With a particularly high prevalence among particular populations, primary angle closure glaucoma (PACG) is responsible for nearly half the glaucoma-related blindness in the world, despite being much less common than open angle disease. PACG occurs as a result of an interruption in the physiological mechanism of aqueous outflow in patients with crowded anterior segment anatomy. Demographic risk factors include older age, female gender and Asiatic race. Family history of glaucoma increases also the risk of developing the disease. Angle closure is rare in children and young adults, only isolated cases and small series, primarily composed of particular ethnicities, having been reported.

PACG and cataract often accompany one another and are both more common among the elderly population. The crystalline plays a critical role in the pathogenesis of the two diseases because of its anatomical proximity with angle structures. Therefore, cataract extraction can be a viable solution for both conditions, because it can deepen the anterior chamber and mechanically open the iridocorneal angle, thus reversing the underlying process in these patients.

We present a rare case of newly diagnosed PACG associated with cataract in a young female in order to underline the efficacy of early phacoemulsification in the control of intraocular pressure.

Case presentation
A 39-year-old Caucasian woman with a family history of glaucoma in one grandparent presented with a two-day history of left sided headache, decreased and blurred vision, as well as pain and redness of the left eye (LE). The patient reported multiple self-limited episodes of headache and pain of the left eye, associated with blurred vision with no apparent exacerbating factors during the previous year. She was not taking prescribed topical ocular or systemic medication and no ocular trauma was declared. Ophthalmological medical history revealed hyperopia of both eyes (right eye (RE) = +1.75 D sphere, LE = +3.75 D sphere).

On presentation, visual acuity (VA) of the LE was limited to counting fingers and intraocular pressure (IOP) of the LE was 42 mmHg (Goldmann Tonometry). Slit lamp examination of the left anterior eye segment revealed the following: conjunctival hyperemia, edematous cornea, relatively normal central anterior chamber (AC) depth, a peripheral AC depth corresponding to Van Herick’s grade 0 and oval, asymmetric, poorly reactive and mid-dilated pupil. Gonioscopic evaluation revealed iridotrabecular contact for 360°, no visible angle structures and a flat–mild convex iris contour. After indentation, the iris contour slightly changed. She was diagnosed with acute primary angle closure. Also, the patient was found to have cataract with visible glaukomflecken in the left lens. Due to corneal edema and lens opacities, fundoscopic examination of the LE was difficult to perform.

The VA of the fellow eye was 100/100 cc (with correction +1.75 D sphere) and IOP 16 mmHg. Anterior segment examination revealed a narrow peripheral AC depth corresponding to Van Herick’s grade 2 and gonioscopic evaluation suggested no abnormality. The posterior segment was also normal.

On the first day only, the patient received the following medication: systemic IOP-lowering agents (mannitol 20% 250 ml x2/day intravenous, acetazolamide 250 mg x2/day per os), IOP lowering drops (brimonidine 0.2% 1 drop x2/day) and topical steroid eye drops (dexamethasone 0.1% 1 drop x4/day). The therapy response allowed IOP control using topical drops (brimonidine 0.2% 1 drop x2/day) for the next five days.

After the resolution of the acute attack, gonioscopy of the LE revealed no anterior peripheral synechiae. Fundoscopy revealed the optic disc with a cup-disc ratio of 0.4. The other part of retina was normal. The digital image of the optic disc suggested only a thinning of neuro-retinal rim at the lower pole, leading to her diagnosis of PACG.

On the sixth day, biometry and of the LE was performed in order to plan cataract surgery (Table 1). A-scan biometry found the left lens thickness to be 4.21mm. The glaukomflecken could not be identified by anterior segment optical coherence tomography or ultrasound biomicroscopy. Endothelial cell count was in normal range. On the seventh day, the patient underwent uneventful phacoemulsification with an intraocular lens implant.

The day after surgery, the VA of the LE was 60/100 sc (without correction) and IOP was 17 mmHg. At discharge the VA of the LE was 80/100 sc (without correction) and the IOP was 13 mmHg. The patient followed the standard post-cataract surgery care.

Table 1. Biomicroscopy of the anterior chamber (normal central depth and peripheral depth Van Herick’s grade 2).

<table>
<thead>
<tr>
<th>Biometry</th>
<th>RE</th>
<th>LE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axial diameter</td>
<td>22.19</td>
<td>21.78</td>
</tr>
<tr>
<td>AC</td>
<td>2.62</td>
<td>2.16</td>
</tr>
<tr>
<td>Lens</td>
<td>4.16</td>
<td>4.22</td>
</tr>
<tr>
<td>Vitreous</td>
<td>15.41</td>
<td>15.39</td>
</tr>
<tr>
<td>CCT</td>
<td>552</td>
<td>557</td>
</tr>
</tbody>
</table>

RE, right eye; LE, left eye; AC, anterior chamber; CCT, central corneal thickness.
(week 1 to 2: topical tobramycin/dexamethasone 3 mg/1 mg/ml 1 drop x4/day and topical bromfenac 0.9 mg/ml 1 drop x4/day, week 3 to 4: topical tobramycin/dexamethasone 3 mg/1 mg/ml 1 drop x2/day and topical bromfenac 0.9 mg/ml 1 drop x2/day).

At the six-week evaluation, VA of the LE was 100/100 sc (without correction) and IOP was appropriate. The field of vision investigated by automated perimetry (Humphrey) appeared normal.

The patient was monitored for VA, IOP, field of vision changes, and optic disc evaluation every six months for 2 years and no glaucomatous change occurred. She also declared no ocular symptom in all this period of time.

**Discussion**

A case with unilateral PACG associated with cataract in such a young patient with no systemic co-morbidities is an unusual presentation. The diagnosis of PACG was preferred, rather than simply primary angle closure, due to the modification of the neuro-retinal rim and the risk factors of the patient, including family history.

This case of unilateral PACG associated with cataract in a young patient with no systemic diseases underlines three aspects: the importance of the risk factors in glaucoma, the relationship between the pathophysiologic mechanisms of the two conditions, and the effectiveness of the phacoemulsification in the IOP control.

The etiology of angle closure in young people is different from that of the older population and is typically associated with structural or developmental ocular particularities: plateau iris, iridociliary cysts, nanophthalmos, etc. In the presented case, the patient had moderate hyperopia in the affected eye and low hyperopia of the fellow eye. Hyperopia is mentioned in literature as a risk factor for PACG. There are, however, studies that did not find any statistically significant correlation between refractive error and PACG. Biometrical parameters such as axial length and AC depth were strongly correlated with PACG. The small axial length (AL) with a normal size lens or even growing lens, as it is in cataract, leads to a crowded anterior segment and a shallow anterior chamber. Thus, the uni-laterality of the condition could be explained in part by the differences in the biometrical parameters between the eyes, the affected having lower values of these parameters. Also, the fellow eye is at risk of developing primary angle closure, and should be monitored.

Another particularity of the disease is the association between the two conditions at the time of diagnosis. The way in which PACG and cataract influence each other in a young patient could be explained, in part, by the presence of glaukomflecken composed of necrotic lens epithelial cells and degenerated subepithelial cortex. These two diseases seem to reinforce each other. Thus, on one side markedly elevated IOP in PACG determined epithelial and anterior cortical lens opacities, on the other side the affected lens growth can compromise the aqueous flow between the lens and iris at the pupil. Therefore, the pupillary block suggested as a mechanism of PACG in older patients could as well appear, even though rare, in younger patients.

Initial therapeutic approach consisted of IOP-lowering medication and, after resolution of the acute attack, phacoemulsification with intraocular lens implant. Iridotomy could have been another viable treatment option, but the presence of a cataractous lens dictated cataract extraction, which is demonstrated to have more favorable results in similar conditions, despite increased risk of corneal edema after phacoemulsification. The patient’s IOP improved, as it is also described in the literature in other cases, after cataractous lens extraction. The patient required no IOP-lowering medication and the first 2 years follow up glaucoma revealed no other glaucomatous damage.

**Conclusions**

The therapeutic choice in PACG (iridotomy vs. phacoemulsification) should be guided by risk factors and the subsequent pathophysiological mechanisms. As our case of PACG associated with cataract in a young patient confirmed, early phacoemulsification proved its effectiveness in the IOP management. Although the risks of surgical approach are well known, especially increased risk of corneal edema, the benefits are undeniable: a good IOP control, decrease need for IOP-lowering drugs and a significant improvement of VA with a better quality of life for the patient.

**Data availability**

All data underlying the results are available as part of the article and no additional source data are required.

**Consent**

Written informed consent for the publication of this case report was obtained from the patient.

**References**

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Summary: This was an interesting case of a young 39-year old patient who developed acute angle closure presumably phacomorphic in etiology. In order to manage her elevated intraocular pressure, the authors performed cataract surgery which successfully reduced her IOP and deepened her angle.

Comments:
1. Can the authors elaborate on the cataract in the case presentation? Which type of cataract and which grade of cataract? It seems atypical for such a young patient to have a unilateral, visually significant cataract. Were other systemic illnesses ruled out? The authors include that the patient denies trauma but were there any other exam findings that suggest trauma? Could there be zonular insufficiency secondary to trauma which would explain the asymmetric narrow angle and the cataract?

2. Did the authors obtain UBM to image the angle and to rule out other potential etiologies of asymmetric, unilateral narrow angles?

3. The first sentence in paragraph 6 in case presentation is missing information. Biometry and what were performed? Was the difference in axial length between the two eyes confirmed with A-scan?

4. Can the authors elaborate on findings of the post-operative follow-up visits? Was formal glaucoma imaging with OCT RNFL, OCT GCC testing performed to evaluate for damage to the optic nerve?

5. In the second to last paragraph in the discussion, the authors seem to suggest that the anterior capsular changes that occurred during her acute angle attack led to pupillary block from the lens. However, the lens thickness between the two eyes is minimal, much smaller than the difference in axial length between the two eyes. Can the authors elaborate?
6. Were the anterior capsular changes the only lenticular changes present? In this young patient who still has accommodation, removing her accommodation with cataract extraction seems to be a large risk when she may have done well with an LPI. I think this thought process and the authors rationale for their treatment choices is a very important part of this case. They seems to only mention that the presence of a cataract was their reasoning but it seems there are other points which should be addressed.

7. The authors suggest that the patient is a case of PACG, however based on her lack of optic nerve cupping and mentioned normal testing - she would not qualify as PACG. Can the authors please address?

**Is the background of the case's history and progression described in sufficient detail?**
Yes

**Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?**
Partly

**Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?**
Partly

**Is the case presented with sufficient detail to be useful for other practitioners?**
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Glaucoma surgical outcomes.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.
Kong, China

The authors presented an unusual but interesting case of APAC in a young female of 39 years old.

Major points:
○ Since the cause of this type of APAC is important, an ultrasound biomicroscopy examination should be included to present the anterior segment structure especially the ciliary body, iris and anterior chamber angle. The difference of the AC between the affected eye and unaffected eye is relative large (2.62 vs 2.16), hence a differential diagnosis is needed in the discussion part, like the discussion on lens dislocation and zonula weakness.

○ The authors should provide a table or relevant figures to show the results of the eye examination about of the VA, IOP, visual field, optic disc evaluation of the LE of different visits.

Minor points:
In the Abstract,
○ Please delete “second only to cataract” in the first sentence, because the sentence structure gives a wrong impression that cataract is also a kind of irreversible blindness.

○ Did the authors intend to stress how the presented case is so unusual as in the second sentence they mentioned PACG is usually bilateral but the presented case is unilateral?

○ What does the “digital image” of the optic disc as mentioned in the 6th sentence in the second paragraph of the abstract stand for? Do you mean the fundus photo?

In the third paragraph of Introduction,
○ Please elaborate more about the “process” mentioned in the last sentence in this paragraph.

In Table 1,
○ What are the units of the measurements of the parameters in Table 1?

In the third paragraph of Discussion,
○ Can the authors please name the parameters specifically that being mentioned in the second last sentence?

In the fifth paragraph of Discussion,
○ Can the authors provide a value about the “increased risk of corneal edema after phacoemulsification”?

Is the background of the case's history and progression described in sufficient detail?
Yes

Are enough details provided of any physical examination and diagnostic tests, treatment given and outcomes?
Partly

Is sufficient discussion included of the importance of the findings and their relevance to future understanding of disease processes, diagnosis or treatment?
Partly
Is the case presented with sufficient detail to be useful for other practitioners?
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Ophthalmic surgical research, Ocular tissue engineering, Eye-on-a-chip.

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

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