REVIEW

Surgical management of chronic angle-closure glaucoma

Yolanda Y. Y. Kwong,[1,2] MRCSEd, Clement C. Y. Tham,[1] FRCS, Jimmy S. M. Lai,[1,3] FRCS, FRCOphth, S. W. Lam,[4] FRCS, Jonathan C. H. Chan,[1,3] FRCS, Robert Ritch,[4,5] MD, FACS, FRCOphth, Dennis S. C. Lam,[1,2] FRCS, FRCOphth

[1]*Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, Hong Kong, China.*
[2]*Hong Kong Eye Hospital, Kowloon, Hong Kong, China.*
[3]*United Christian Hospital, Kowloon, Hong Kong, China.*
[4]*Einhorn Clinical Center, New York Eye and Ear Infirmary, New York, New York, USA.*
[5]*Department of Ophthalmology, New York Medical College, Valhalla, New York, USA.*

Correspondence and reprint requests:
Clement C. Y. Tham, Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, 3/F Hong Kong Eye Hospital, 147K Argyle Street, Kowloon, Hong Kong. Tel: (852) 2762 3196; Fax: (852) 2816 7093; E-mail: clemtham@hkstar.com

Abstract

Chronic angle-closure glaucoma is a major cause of blindness, particularly in Asia. The goals of management are to prevent both progression of anatomic angle-closure and progression of glaucomatous optic neuropathy, the latter by controlling intraocular pressure. Laser iridotomy to eliminate pupillary block is the definitive initial treatment and laser peripheral iridoplasty is the second-line treatment to eliminate any residual appositional angle-closure.

Topical medications are used if the intraocular pressure remains uncontrolled. If the target pressure is not reached with maximally tolerated medications, surgery is indicated. Options include trabeculectomy with or without lens extraction, lens extraction alone, combined phacoemulsification and non-penetrating deep sclerectomy, goniosynechialysis with or without lens extraction, cyclodestructive procedures, and glaucoma drainage implants.

Recently, lens extraction has been actively studied and appears to be promising as an effective treatment, since it reverses the anatomical predisposition to angle-closure. More work needs to be done to define its role in the management of chronic angle-closure glaucoma.

Key words: Glaucoma, angle-closure, Glaucoma drainage implants, Iridectomy, Phacoemulsification, Trabeculectomy

Introduction

Angle-closure refers to the apposition or adhesion of the peripheral iris to the pigmented trabecular meshwork, blocking aqueous access to the filtering meshwork. Blockage can be temporary (appositional) or permanent (synechial), and can be complete or partial. A sufficient proportion of the drainage surface of the trabecular meshwork must be blocked before the intraocular pressure (IOP) begins to rise. A persistently raised IOP can result in irreversible optic nerve head cupping and visual field loss, depending on the susceptibility of the individual's optic nerve to the damaging effect of pressure.

Angle-closure glaucoma can be subdivided into acute and chronic types. The acute form is symptomatic and results from the sudden appositional closure of the angle leading to a dramatic rise in IOP. Chronic angle-closure glaucoma (CACG) refers to an eye in which portions of the anterior chamber angle are closed permanently by peripheral anterior synechiae (PAS). Glaucomatous damage is present and the disease is asymptomatic, at least in its early stages. Eyes with progressive PAS formation may eventually develop acute angle-closure when pupillary block results in sudden closure of the remaining portions of the angle unaffected by PAS. However, many patients develop gradual angle-closure, PAS, elevated IOP, and glaucomatous damage in the absence of symptoms. CACG may also develop following an acute angle-closure attack.

The management of CACG is to prevent progression of angle-closure and glaucomatous optic neuropathy by

controlling IOP. Laser iridotomy and laser peripheral iridoplasty are definitive treatments in the initial stages of management, and act by eliminating pupil block and appositional angle-closure, respectively. Topical medications are then used if the IOP remains uncontrolled. If the target IOP is not reached with maximally tolerated medications, surgery needs to be considered. Surgical options include lens extraction alone, trabeculectomy with or without lens extraction, combined phacoemulsification and non-penetrating deep sclerectomy, goniosynechialysis with or without lens extraction, cyclodestructive procedures, and glaucoma drainage implants.

Trabeculectomy

Trabeculectomy is effective for CACG (**Figure 1**).[1,2] However, trabeculectomy for CACG is associated with a higher risk of filtration failure, shallow anterior chamber, and malignant glaucoma than for primary open-angle glaucoma (POAG).[3,4] As the incidence of CACG increases with age, many patients with CACG have co-existing cataract. Trabeculectomy increases the rate of cataract progression, and a significant proportion of patients will need cataract extraction after trabeculectomy.[5-9] Furthermore, future cataract extraction may result in loss of the functioning filter.[8,10-20] It has been reported that 30% to 100% of previously functioning blebs may require antiglaucoma medications to control IOP after cataract extraction.[8] Trabeculectomy alone is, therefore, not the ideal surgical option for medically uncontrolled CACG.

Trabeculectomy is associated with various complications, both early and late, including bleb leaks and bleb-related infections. These risks are further increased by use of adjunctive antimetabolites.

Lens extraction for chronic angle-closure glaucoma

Lens position and thickness both play important roles in the etiology of angle-closure glaucoma.[21-24] Lens extraction significantly increases anterior chamber depth and width of the drainage angle.[25] Both traditional extracapsular cataract extraction[6,26,27] and phacoemulsification[28-32] have been reported to lower IOP in CACG. Removal of a large cataractous lens from an eye with a crowded anterior segment may improve aqueous outflow.[33] It has also been postulated that during phacoemulsification, the irrigating fluid flushes cellular debris from the trabecular meshwork, decreasing resistance to aqueous outflow.[34] One study suggested that the IOP-lowering effect of lens extraction may be less pronounced in patients with CACG with PAS covering three-quarters or more of the angle.[35] Lens extraction alone may therefore have a role in improving IOP control in CACG, especially in patients with less extensive PAS and when the IOP is not severely out of control. No randomized controlled trials have compared the efficacy and safety of lens extraction to other glaucoma surgeries in CACG.[36] Two randomized controlled trials are currently being undertaken by the authors to investigate the effects of lens extraction in CACG with and without cataract. IOP control, surgical complications, and additional interventions for IOP control are important outcome measures in these studies.

Combined lens extraction and trabeculectomy

Trabeculectomy for CACG is often combined with cataract extraction and intraocular lens (IOL) implantation. Since cataract extraction alone widens the angle and lowers IOP in CACG, trabeculectomy combined with cataract extraction has a greater IOP-lowering effect in CACG than in POAG.[37] However, there are no published data documenting the additional IOP-lowering effect of combined phacotrabeculectomy over trabeculectomy alone in CACG. Combined surgery also improves patients' visual acuity and quality of life, and has the added advantage of reducing the risk of anterior chamber shallowing or flattening. These authors therefore recommend combined phacotrabeculectomy for patients with CACG with some degree of cataract, especially when the IOP is not well controlled with maximally tolerated medications.

Combined phacoemulsification and non-penetrating filtering procedures

Non-penetrating glaucoma-filtering procedures have increasingly gained acceptance during the past few decades, and are known for their safety and low risk profiles.[38-40] Combined phacoemulsification and non-penetrating deep sclerectomy has been shown to reduce IOP and the number of antiglaucoma medications used for CACG.[41] However, there is currently only one retrospective study mentioning this procedure's role in CACG and further studies are needed to compare the IOP-lowering effect with that of trabeculectomy.

Goniosynechialysis with or without lens extraction

Goniosynechialysis is a surgical technique performed to strip the PAS from the trabecular surface in the angle, so that aqueous can have renewed access to the trabecular meshwork. In eyes with minimal PAS, trabeculectomy is preferred because trabecular function in these eyes is expected to be poor and a fistula procedure would be more appropriate. On the other hand, there may be spikes of raised IOP during and after the goniosynechialysis procedure, leading to loss of vision. Goniosynechialysis is more suitable for eyes with minimal to moderate degree of neuronal damage.

In the past, ophthalmologists have tried to sweep open closed angles without direct visualization. This often failed because accurate instrument placement could not be achieved. In 1984, Campbell and Vela introduced a technique using direct intraoperative visualization of the angle and anterior chamber deepening with viscoelastic agents.[42] Visualization has been further improved with the use of

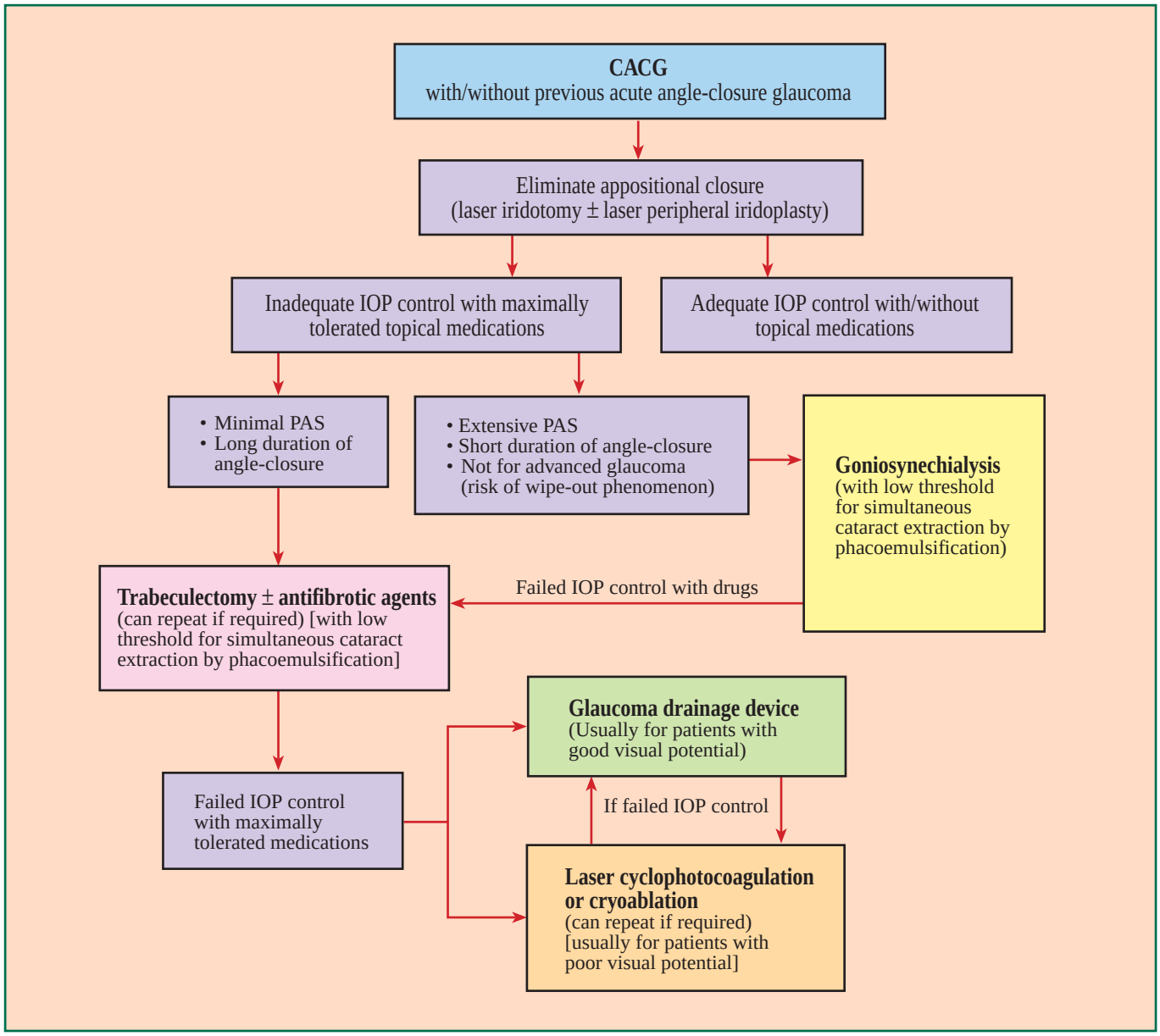

Figure 1. One approach to the management of chronic angle-closure glaucoma.
***Abbreviations*: CACG = chronic angle-closure glaucoma; IOP = intraocular pressure; PAS = peripheral anterior synechiae.**

the Swan-Jacob lens. This specially designed lens has a handle attached to a small diameter prism so that it will not obstruct the spatula from entering the anterior chamber at the limbus. When PAS has been present for less than 1 year, the overall success rate in terms of IOP control is approximately 80%.[43,44] Irreversible damage to the trabecular meshwork may occur in areas of synechial closure, with proliferation of iris or fibrous tissue into the intertrabecular space. For goniosynechialysis to be effective, it must be performed before there is irreversible histological change in the trabecular meshwork. The mechanisms causing the angle-closure should also be eliminated by performing peripheral iridotomy, laser peripheral iridoplasty,[45-47] or lens extraction,[48,49] either alone or in combination, to minimize the possibility of recurrent closure. Tanihara and Nagata reported success with goniosynechialysis followed by argon laser peripheral iridoplasty.[45] Lai et al reported 5 patients with an 80% success rate using limited goniosynechialysis followed by diode laser peripheral iridoplasty.[46]

Lens extraction has the advantages of noticeable visual improvement after surgery; furthermore, removal of the lens increases the anterior chamber depth and widens the angle, and may decrease the possibility of recurrent angle-closure. However, lens extraction alone could not open a PAS; goniosynechialysis strips open the PAS. Combining goniosynechialysis with lens extraction has a greater IOP-lowering effect than goniosynechialysis alone.[43,47-49] In the study by Teekhasaenee and Ritch, 12 patients who had uncontrolled IOP after initial goniosynechialysis alone had IOPs less than 20 mm Hg without medication after combined phacoemulsification and goniosynechialysis, and the mean extent of PAS was reduced from 310° to 60°.[48] Teekhasaenee

and Ritch have reported success with phacoemulsification combined with goniosynechialysis,[48] and Lai et al were successful with combined phacoemulsification and limited goniosynechialysis, followed by diode laser peripheral iridoplasty, for CACG.[47] These authors demonstrated with ultrasound biomicroscopy that lens removal for CACG would only deepen the peripheral anterior chamber, without opening up the angle, while gonio-synechialysis opened up the angle and allowed aqueous access to the trabecular meshwork. Nevertheless, both lens extraction and goniosynechialysis performed alone have been shown to lower the IOP, although the mechanisms are uncertain and may or may not be common to both procedures.

The most common complication of goniosynechialysis is intraoperative hemorrhage.[43] Other complications include IOP elevation on the first postoperative day,[47,48] iridodialysis, cyclodialysis, and lens damage.[43]

Cyclodestructive procedures

Transscleral diode laser cyclophotocoagulation (TSCPC) using the G-probe is used to treat different types of glaucoma.[50] The semiconductor diode laser emits light of wavelength 810 nm, near the infrared spectrum. The light is transmitted through the sclera and absorbed by melanin. The success rates for cyclodestruction vary among the different types of procedures and glaucomas. Diode TSCPC has been reported to be effective for controlling IOP to <21 mm Hg in 70% to 81% of children and adults with refractory glaucoma.[51] However, there has been no large-scale study of its efficacy for the treatment of CACG. In a recent study, adjunctive diode TSCPC was effective in lowering IOP in 4 patients with CACG that was uncontrolled despite a glaucoma aqueous tube shunt and multiple medications.[52] In the study by Lai et al, diode TSCPC appeared to be an effective and safe primary surgical treatment for medically uncontrolled CACG, with an IOP-lowering effect persisting for up to 2 years.[53]

The efficacy and relative safety, the portability of the equipment, the ease of learning, and the short duration required for performing this technique make diode TSCPC a potential primary or secondary surgical procedure for the future treatment of CACG. However, TSCPC is associated with some common complications, including uveitis and pupillary distortion, which may precipitate further PAS formation, and some rare but potentially serious complications, including conjunctival burns, hyphema, chronic hypotony, cystoid macular edema, retinal detachment, phthisis bulbi, and scleral perforations.[51,54-61]

Glaucoma drainage implants

There is a wide variety of glaucoma drainage devices, ranging from the early Molteno implant to the currently popular valve-equipped variety such as the Ahmed implant.[62] As implantation of a glaucoma drainage device is technically more difficult than trabeculectomy[63-68] and potentially serious complications can occur,[69-80] the use of a glaucoma implant for CACG has been mainly confined to those patients for whom one or more previous filtering procedures have failed. Amongst the studies that included CACG, the proportion of patients with CACG ranged from 1.7% to 9.0%. Aside from the small number of patients, another major problem with these studies is that only 2 published the results of the subgroup with CACG. One had only a single non-Asian patient with angle-closure glaucoma who had no light perception at 6 months,[81] while the other included 10 patients of unspecified race, 7 of whom had successful surgery.[82] A more recent randomized study evaluated non-valved tube shunt surgery against trabeculectomy for patients with glaucoma who had previously failed trabeculectomy and/or cataract extraction with IOL implantation.[83-85] In this study, there were 18 eyes with CACG, with 7 randomized to the implant group and 11 to the trabeculectomy group.[83] Although this study did not provide a subgroup analysis for patients with CACG, the 1-year results found a higher success rate in the implant group than in the trabeculectomy group.[84] These results suggest a possible expanded role for the use of implants in eyes that have had previous ocular surgery.

Conclusions

The best surgical strategy for medically uncontrolled CACG is not yet clearly defined. There is a lack of high-quality clinical data from randomized controlled trials to compare different surgical modalities. In the absence of comparative data, the choice of surgical treatment often depends on the surgeon's expertise and preference.

For CACG with recent synechial angle-closure, combined phacoemulsification and goniosynechialysis may be a logical approach. However, in the presence of substantial visual field defects and/or advanced cupping, signifying a long duration of angle-closure, irreversible structural changes in the trabecular meshwork are expected, and goniosynechialysis may not be effective for these patients. Trabeculectomy, with or without combined lens extraction, may be considered for medically uncontrolled and long-standing CACG. Combined phacoemulsification and non-penetrating deep sclerectomy is an option, but more work needs to be done. Currently, glaucoma implants and cyclodestruction are reserved for patients with CACG who have failed previous filtering operations. The choice between glaucoma implants and cyclodestruction usually depends on the patient's visual prognosis, with cyclodestruction being reserved for those patients with poorer visual prognosis because of the destructive nature of the procedure.

None of the conventional glaucoma procedures appear to be ideal for CACG. Since lens extraction reverses the anatomical predisposition to angle-closure, this procedure holds promise as an effective primary treatment for CACG, especially in the early stages of the disease. Data from ongoing randomized controlled trials may help define a role for lens extraction in the surgical management of CACG in the future.

References

1. *Sihota R, Gupta V, Agarwal HC. Long-term evaluation of trabeculectomy in primary open angle glaucoma and chronic primary angle closure glaucoma in an Asian population. Clin Exp Ophthalmol. 2004;32:23-8.*
2. *Tham CC, Lai JS, Poon AS, Lai TY, Lam DS. Results of trabeculectomy with adjunctive intraoperative mitomycin C in Chinese patients with glaucoma. Ophthalmic Surg Lasers Imaging. 2006;37:33-41.*
3. *Inaba Z. Long-term results of trabeculectomy in the Japanese: an analysis by life-table method. Jpn J Ophthalmol. 1982;26:361-73.*
4. *Trope GE, Pavlin CJ, Bau A, Baumal CR, Foster FS. Malignant glaucoma. Clinical and ultrasound biomicroscopic features. Ophthalmology. 1994;101:1030-5.*
5. *The Advanced Glaucoma Intervention Study: 8. Risk of cataract formation after trabeculectomy. Arch Ophthalmol. 2001; 119:1771-9.*
6. *Gunning FP, Greve EL. Lens extraction for uncontrolled angle-closure glaucoma: long-term follow-up. J Cataract Refract Surg. 1998;24:1347-56.*
7. *D'Ermo F, Bonomi L, Doro D. A critical analysis of the long-term results of trabeculectomy. Am J Ophthalmol. 1979;88: 829-35.*
8. *Halikiopoulos D, Moster MR, Azuara-Blanco A, et al. The outcome of the functioning filter after subsequent cataract extraction. Ophthalmic Surg Lasers. 2001;32:108-17.*
9. *Hylton C, Congdon N, Friedman D, et al. Cataract after glaucoma filtration surgery. Am J Ophthalmol. 2003;135: 231-2.*
10. *Alpar JJ. Cataract extraction and lens implantation in eyes with pre-existing filtering blebs. J Am Intraocul Implant Soc. 1979;5:33-5.*
11. *Antonios SR, Traverso CE, Tomey KF. Extracapsular cataract extraction using a temporal limbal approach after filtering operations. Arch Ophthalmol. 1988;106: 608-10.*
12. *Binkhorst CD, Huber C. Cataract extraction and intraocular lens implantation after fistulizing glaucoma surgery. J Am Intraocul Implant Soc. 1981;7:133-7.*
13. *Brooks AM, Gillies WE. The effect of cataract extraction with implant in glaucomatous eyes. Aust N Z J Ophthalmol. 1992; 20:235-8.*
14. *Murchison JF Jr, Shields MB. An evaluation of three surgical approaches for coexisting cataract and glaucoma. Ophthalmic Surg. 1989;20:393-8.*
15. *Obstbaum SA. Glaucoma and intraocular lens implantation. J Cataract Refract Surg. 1986;12:257-61.*
16. *Chen PP, Weaver YK, Budenz DL, Feuer WJ, Parrish RK 2nd. Trabeculectomy function after cataract extraction. Ophthalmology. 1998;105:1928-35.*
17. *Dickens MA, Cashwell LF. Long-term effect of cataract extraction on the function of an established filtering bleb. Ophthalmic Surg Lasers. 1996;27:9-14.*
18. *Seah SK, Jap A, Prata JA Jr, et al. Cataract surgery after trabeculectomy. Ophthalmic Surg Lasers. 1996;27: 587-94.*
19. *Swamynathan K, Capistrano AP, Cantor LB, WuDunn D. Effect of temporal corneal phacoemulsification on intraocular pressure in eyes with prior trabeculectomy with an antimetabolite. Ophthalmology. 2004;111:674-8.*
20. *Yamagami S, Araie M, Mori M, Mishima K. Posterior chamber intraocular lens implantation in filtered or nonfiltered glaucoma eyes. Jpn J Ophthalmol. 1994;38:71-9.*
21. *Foster PJ. The epidemiology of primary angle closure and associated glaucomatous optic neuropathy. Semin Ophthalmol. 2002;17:50-8.*
22. *Lowe RF. Causes of shallow anterior chamber in primary angle-closure glaucoma. Ultrasonic biometry of normal and angle-closure glaucoma eyes. Am J Ophthalmol. 1969;67: 87-93.*
23. *Lowe RF. Aetiology of the anatomical basis for primary angle-closure glaucoma. Biometrical comparisons between normal eyes and eyes with primary angle-closure glaucoma. Br J Ophthalmol. 1970;54:161-9.*
24. *Tornquist R. Chamber depth in primary acute glaucoma. Br J Ophthalmol. 1956;40:421-9.*
25. *Hayashi K, Hayashi H, Nakao F, Hayashi F. Changes in anterior chamber angle width and depth after intraocular lens implantation in eyes with glaucoma. Ophthalmology. 2000;107:698-703.*
26. *Acton J, Salmon JF, Scholtz R. Extracapsular cataract extraction with posterior chamber lens implantation in primary angle-closure glaucoma. J Cataract Refract Surg. 1997;23:930-4.*
27. *Wishart PK, Atkinson PL. Extracapsular cataract extraction and posterior chamber lens implantation in patients with primary chronic angle-closure glaucoma: effect on intraocular pressure control. Eye. 1989;3 (Pt 6):706-12.*
28. *Suzuki R, Tanaka K, Sagara T, Fujiwara N. Reduction of intraocular pressure after phacoemulsification and aspiration with intraocular lens implantation. Ophthalmologica. 1994;208:254-8.*
29. *Hayashi K, Hayashi H, Nakao F, Hayashi F. Effect of cataract surgery on intraocular pressure control in glaucoma patients. J Cataract Refract Surg. 2001;27:1779-86.*
30. *Jacobi PC, Dietlein TS, Lüke C, Engels B, Kriegelstein GK. Primary phacoemulsification and intraocular lens implantation for acute angle-closure glaucoma. Ophthalmology. 2002;109:1597-603.*
31. *Kubota T, Toguri I, Onizuka N, Matsuura T. Phacoemulsification and intraocular lens implantation for angle closure glaucoma after the relief of pupillary block. Ophthalmologica. 2003;217:325-8.*
32. *Lai JS, Tham CC, Chan JC. The clinical outcomes of cataract extraction by phacoemulsification in eyes with primary angle-closure glaucoma (PACG) and co-existing cataract: a prospective case series. J Glaucoma. 2006;15:47-52.*
33. *Meyer MA, Savitt ML, Kopitas E. The effect of phacoemulsification on aqueous outflow facility. Ophthalmology. 1997; 104:1221-7.*
34. *Kim DD, Doyle JW, Smith MF. Intraocular pressure reduction following phacoemulsification cataract extraction with posterior chamber lens implantation in glaucoma patients. Ophthalmic Surg Lasers. 1999;30:37-40.*
35. *Euswas A, Warrasak S. Intraocular pressure control following phacoemulsification in patients with chronic angle closure glaucoma. J Med Assoc Thai. 2005;88(Suppl 9): S121-5.*
36. *Friedman DS, Vedula SS. Lens extraction for chronic angle-closure glaucoma. Cochrane Database Syst Rev. 2006;3: CD005555.*
37. *Lai JS, Tham CC, Chan JC, Lam DS. Phacotrabeculectomy in treatment of primary angle-closure glaucoma and primary open-angle glaucoma. Jpn J Ophthalmol. 2004;48:408-11.*
38. *Karlen ME, Sanchez E, Schnyder CC, Sickenberg M, Mermoud A. Deep sclerectomy with collagen implant: medium terms results. Br J Ophthalmol. 1999;83:6-11.*
39. *Drolsum L. Conversion from trabeculectomy to deep sclerectomy. Prospective study of the first 44 cases. J Cataract Refract Surg. 2003;29:1378-84.*
40. *Zimmerman TJ, Mandlekorn RM, Kooner KS, et al. Effectiveness of nonpenetrating trabeculectomy in aphakic patients with glaucoma. Ophthalmic Surg. 1984;15:44-50.*
41. *Yuen NS, Chan OC, Hui SP, Ching RH. Combined*

phacoemulsification and nonpenetrating deep sclerectomy in the treatment of chronic angle-closure glaucoma with cataract. Eur J Ophthalmol. 2007;17:208-15.

42. *Campbell DG, Vela A. Modern goniosynechialysis for the treatment of synechial angle-closure glaucoma. Ophthalmology. 1984;91:1052-60.*
43. *Tanihara H, Nishiwaki K, Nagata M. Surgical results and complications of goniosynechialysis. Graefes Arch Clin Exp Ophthalmol. 1992;230:309-13.*
44. *Tanihara H, Negi A, Akimoto M, Nagata M. Long-term results of non-filtering surgery for the treatment of primary angle-closure glaucoma. Graefes Arch Clin Exp Ophthalmol. 1995;233:563-7.*
45. *Tanihara H, Nagata M. Argon-laser gonioplasty following goniosynechialysis. Graefes Arch Clin Exp Ophthalmol. 1991;229:505-7.*
46. *Lai JS, Tham CC, Chua JK, Lam DS. Efficacy and safety of inferior 180 degrees goniosynechialysis followed by diode laser peripheral iridoplasty in the treatment of chronic angle-closure glaucoma. J Glaucoma. 2000;9:388-91.*
47. *Lai JS, Tham CC, Lam DS. The efficacy and safety of combined phacoemulsification, intraocular lens implantation, and limited goniosynechialysis, followed by diode laser peripheral iridoplasty, in the treatment of cataract and chronic angle-closure glaucoma. J Glaucoma. 2001;10:309-15.*
48. *Teekhasaenee C, Ritch R. Combined phacoemulsification and goniosynechialysis for uncontrolled chronic angle-closure glaucoma after acute angle-closure glaucoma. Ophthalmology. 1999;106:669-74.*
49. *Harasymowycz PJ, Papamatheakis DG, Ahmed I, et al. Phacoemulsification and goniosynechialysis in the management of unresponsive primary angle closure. J Glaucoma. 2005;14:186-9.*
50. *Hennis HL, Stewart WC. Semiconductor diode laser transscleral cyclophotocoagulation in patients with glaucoma. Am J Ophthalmol. 1992;113:81-5.*
51. *Bloom PA, Tsai JC, Sharma K, et al. "Cyclodiode". Transscleral diode laser cyclophotocoagulation in the treatment of advanced refractory glaucoma. Ophthalmology. 1997; 104:1508-19.*
52. *Semchyshyn TM, Tsai JC, Joos KM. Supplemental transscleral diode laser cyclophotocoagulation after aqueous shunt placement in refractory glaucoma. Ophthalmology. 2002;109:1078-84.*
53. *Lai JS, Tham CC, Chan JC, Lam DS. Diode laser transscleral cyclophotocoagulation in the treatment of chronic angle-closure glaucoma: a preliminary study. J Glaucoma. 2003; 12:360-4.*
54. *Bhola RM, Prasad S, McCormick AG, Rennie IG, Talbot JF, Parsons MA. Pupillary distortion and staphyloma following trans-scleral contact diode laser cyclophotocoagulation: a clinicopathological study of three patients. Eye. 2001; 15:453-7.*
55. *Bock CJ, Freedman SF, Buckley EG, Shields MB. Transscleral diode laser cyclophotocoagulation for refractory pediatric glaucomas. J Pediatr Ophthalmol Strabismus. 1997;34:235-9.*
56. *Gaasterland DE, Pollack IP. Initial experience with a new method of laser transscleral cyclophotocoagulation for ciliary ablation in severe glaucoma. Trans Am Ophthalmol Soc. 1992;90:225-43.*
57. *Kosoko O, Gaasterland DE, Pollack IP, Enger CL. Long-term outcome of initial ciliary ablation with contact diode laser transscleral cyclophotocoagulation for severe glaucoma. The Diode Laser Ciliary Ablation Study Group. Ophthalmology. 1996;103:1294-302.*
58. *Kwong YY, Tham CC, Leung DY, Lam DS. Scleral perforation following diode laser trans-scleral cyclophotocoagulation. Eye. 2006;20:1316-7.*
59. *Mastrobattista JM, Luntz M. Ciliary body ablation: where are we and how did we get here? Surv Ophthalmol. 1996; 41:193-213.*
60. *Sabri K, Vernon SA. Scleral perforation following transscleral cyclodiode. Br J Ophthalmol. 1999;83:502-3.*
61. *Schlote T, Derse M, Thiel HJ, Jean B. Pupillary distortion after contact transscleral diode laser cyclophotocoagulation. Br J Ophthalmol. 2000;84:337-8.*
62. *Schwartz KS, Lee RK, Gedde SJ. Glaucoma drainage implants: a critical comparison of types. Curr Opin Ophthalmol. 2006;17:181-9.*
63. *Egbert PR, Lieberman MF. Internal suture occlusion of the Molteno glaucoma implant for the prevention of postoperative hypotony. Ophthalmic Surg. 1989;20:53-6.*
64. *El Sayyad F, el Maghraby A, Helal M, Amayem A. The use of releasable sutures in Molteno glaucoma implant procedures to reduce postoperative hypotony. Ophthalmic Surg. 1991;22:82-4.*
65. *Tanji TM, Lundy DC, Minckler DS, Heuer DK, Varma R. Fascia lata patch graft in glaucoma tube surgery. Ophthalmology. 1996;103:1309-12.*
66. *Lam DS, Cheuk W, Lai JS. Short-term results of using lamellar corneo-scleral patch graft for the Ahmed glaucoma valve implant surgery. Yan Ke Xue Bao. 1997;13:109-12.*
67. *Raviv T, Greenfield DS, Liebmann JM, Sidoti PA, Ishikawa H, Ritch R. Pericardial patch grafts in glaucoma implant surgery. J Glaucoma. 1998;7:27-32.*
68. *Emerick GT, Gedde SJ, Budenz DL. Tube fenestrations in Baerveldt Glaucoma Implant surgery: 1-year results compared with standard implant surgery. J Glaucoma. 2002; 11:340-6.*
69. *Ball SF, Ellis GS Jr, Herrington RG, Liang K. Brown's superior oblique tendon syndrome after Baerveldt glaucoma implant. Arch Ophthalmol. 1992;110:1368.*
70. *Sidoti PA, Minckler DS, Baerveldt G, Lee PP, Heuer DK. Epithelial ingrowth and glaucoma drainage implants. Ophthalmology. 1994;101:872-5.*
71. *Waterhouse WJ, Lloyd MA, Dugel PU, et al. Rhegmatogenous retinal detachment after Molteno glaucoma implant surgery. Ophthalmology. 1994;101:665-71.*
72. *Aung T, Seah SK. Glaucoma drainage implants in Asian eyes. Ophthalmology. 1998;105:2117-22.*
73. *Oh KT, Alward WL, Kardon RH. Myositis associated with a Baerveldt glaucoma implant. Am J Ophthalmol 1999;128: 375-6.*
74. *Coats DK, Paysse EA, Orenga-Nania S. Acquired Pseudo-Brown's syndrome immediately following Ahmed valve glaucoma implant. Ophthalmic Surg Lasers. 1999;30:396-7.*
75. *Desatnik HR, Foster RE, Rockwood EJ, Baerveldt G, Meyers SM, Lewis H. Management of glaucoma implants occluded by vitreous incarceration. J Glaucoma. 2000;9:311-6.*
76. *Lai JS, Poon AS, Chua JK, Tham CC, Leung AT, Lam DS. Efficacy and safety of the Ahmed glaucoma valve implant in Chinese eyes with complicated glaucoma. Br J Ophthalmol. 2000;84:718-21.*
77. *King AJ, Azuara-Blanco A. Pericardial patch melting following glaucoma implant insertion. Eye. 2001;15:236-7.*
78. *Jewelewicz DA, Rosenfeld SI, Litinsky SM. Epithelial downgrowth following insertion of an Ahmed glaucoma implant. Arch Ophthalmol. 2003;121:285-6.*
79. *Harbick KH, Sidoti PA, Budenz DL, et al. Outcomes of inferonasal Baerveldt glaucoma drainage implant surgery. J Glaucoma. 2006;15:7-12.*
80. *Chan CH, Lai JS, Shen SY. Delayed retrobulbar haemorrhage after Ahmed glaucoma implant: a case report. Eye. 2006;20:494-5.*
81. *Krishna R, Godfrey DG, Budenz DL, et al. Intermediate-*

term outcomes of 350-mm(2) Baerveldt glaucoma implants. Ophthalmology. 2001;108:621-6.
82. *Ayyala RS, Zurakowski D, Smith JA, et al. A clinical study of the Ahmed glaucoma valve implant in advanced glaucoma. Ophthalmology. 1998;105:1968-76.*
83. *Gedde SJ, Schiffman JC, Feuer WJ, et al. The tube versus trabeculectomy study: design and baseline characteristics of study patients. Am J Ophthalmol. 2005;140:275-87.*
84. *Gedde SJ, Schiffman JC, Feuer WJ, Herndon LW, Brandt JD, Budenz DL. Treatment outcomes in the tube versus trabeculectomy study after one year of follow-up. Am J Ophthalmol. 2007;143:9-22.*
85. *Gedde SJ, Herndon LW, Brandt JD, Budenz DL, Feuer WJ, Schiffman JC. Surgical complications in the Tube Versus Trabeculectomy Study during the first year of follow-up. Am J Ophthalmol. 2007;143:23-31.*

香 港 眼 科 醫 學 院

CME

Continuing Medical Education (CME) points will be awarded to authors of articles accepted for publication in Hong Kong Journal of Ophthalmology, who are Fellows of the College of Ophthalmologists of Hong Kong.

Up to 10 active CME points may be awarded to the first author of Original Articles with data analysis.

Up to 5 active CME points may be awarded to the first author of other categories of articles.

Half the number of points will be accredited to each of the other authors of the publication.

Publications may be accredited a maximum of 75 active CME points per three-year cycle.

Active CME points will also be awarded to Fellows of the College of Ophthalmologists of Hong Kong who answer 4 or more of the Multiple Choice Questions in this issue of HKJO correctly. Half active CME point will be awarded for each question answered correctly.

The above serves as a guideline only. The accreditation of CME points requires the application to, and approval by, the College of Ophthalmologists of Hong Kong.