



Issue 22
August 2001

Issues in Emerging Health Technologies

Non-Penetrating Glaucoma Surgery Using AquaFlow™ Collagen Implants

Summary

- ✓ **AquaFlow™ is an absorbable collagen implant for use in non-penetrating surgery for primary open angle glaucoma. Its purpose is to facilitate drainage of fluid from the eye, thereby reducing intraocular pressure.**
- ✓ **AquaFlow™ is approved for use in Canada in medically refractory cases of primary open angle glaucoma.**
- ✓ **Non-penetrating glaucoma surgery with the AquaFlow™ implant appears to be a relatively safe procedure. However, there is a steep learning curve for the surgeon and it is initially associated with a high rate of conversion to conventional surgery during the operation.**
- ✓ **Limited evidence from small non-randomized trials suggests that the AquaFlow™ implant may offer benefits over conventional surgical approaches in terms of reduced complication rates, reduced medication use, an earlier return of improved vision and sustained control of intraocular pressure. However, the efficacy and cost-effectiveness of this approach have not been established.**

The Technology

Glaucoma is a condition where damage to the optic nerve, usually due to increased fluid pressure in the eye, leads to progressive vision loss. The elevated intraocular pressure (IOP) is caused by a reduced capacity of the eye to drain fluids from inside the eyeball. Primary open angle

glaucoma (POAG), the most common type of glaucoma, is caused by degeneration of the drainage channels in the eye.

Conventional surgical management of POAG involves penetrating the sclera (the white outer membrane covering the eyeball) near the iris, allowing drainage. Non-penetrating glaucoma surgery involves removing a partial thickness of a small segment of the sclera to produce a controlled leakage of fluid to reduce IOP. Non-penetrating surgery may be augmented by placing a filtration implant in the partial thickness surgical bed during the operation. AquaFlow™ is a collagen implant (lyophilised gamma irradiated porcine scleral collagen) for use in non-penetrating surgery for POAG. The implant is slowly absorbed over six to nine months, leaving a patent drainage channel that provides prolonged filtration and sustained control of intraocular pressure.¹

AquaFlow™ is manufactured in Nidau, Switzerland by STAAR Surgical and is distributed in Canada through Surge Canada Distribution Ltd, in Cambridge, Ontario.

Regulatory Status

AquaFlow™ was approved in Canada in January, 2001 for use in patients with uncontrolled intraocular pressure due to primary open angle glaucoma after failure to respond adequately to maximum tolerated medical therapy (R. McDonald, Surge Canada Distribution Ltd, Cambridge (ON): personal communication, May, 2001). Thus far, there has been only limited use of the technology in Canada. The device recently received pre-market approval from the U.S. Food and Drug Administration, but it has had the CE Mark approval for marketing in Europe since 1997.

Patient Group

About 300,000 Canadians suffer from glaucoma. Primary open angle glaucoma accounts for about 90% of all glaucoma cases.² The incidence of glaucoma increases with age and is more common amongst blacks, Inuit and Asians, than Caucasians. Relatives of people with POAG are at increased risk of developing the condition. Glaucoma is the second leading cause of blindness in Canadians over the age of 50.³

Current Practice

The goal of therapy is to reduce IOP and to stop further damage to the optic nerve.⁴ Primary open angle glaucoma is usually treated medically with eye drops, which reduce IOP by decreasing the production of intraocular fluid or by increasing the flow of fluids out of the eyeball. When medical therapy fails, laser therapy may be attempted. Surgery is considered if IOP remains uncontrolled. Conventional surgery decreases IOP by penetrating the sclera to create small channels to facilitate the flow of fluid.

To promote continued drainage of fluid, certain drugs, such as 5-fluorouracil or mitomycin C, can be used to reduce scarring and to prolong drainage in the healing surgical beds.

Administration and Cost

No cost-effectiveness data are currently available. The cost of the AquaFlow™ device in Canada is about C \$650 per unit (R. McDonald, Surge Canada Distribution Ltd, Cambridge (ON): personal communication, May, 2001). Costs of the associated non-penetrating surgery might be expected to be similar to those of trabeculectomy (surgical full thickness penetration of the sclera), though some additional costs may be incurred when conversion to conventional surgery is needed. However, potential savings could arise from a reduction in postoperative complication rates, reduction in medication use and possible earlier return to work by the patient.

Projected Rate of Diffusion

Non-penetrating surgery is technically demanding. It is associated with a steep learning curve with an initial 33-40% rate of intraoperative conversion to conventional surgery due to inadvertent penetration of the sclera. Conversion rates drop to 3-5% for more experienced surgeons.⁵ Some patients need postoperative laser therapy at the surgical site when insufficient filtration is suspected.⁶ Such postoperative sequelae may discourage the use of the device by some specialists.

In addition, the use of AquaFlow™ may compete with other surgical techniques. The comparative efficacy of the various approaches is uncertain and this may also slow diffusion.

Concurrent Developments

Other penetrating and non-penetrating surgical devices are being developed. These can be broadly categorized as implants (collagen, hyaluronic acid); shunts (passive tubular drainage), and valves (unidirectional drainage). For example, viscocanalostomy is a non-penetrating surgical approach that uses a high molecular weight sodium hyaluronate viscoelastic. This procedure is also technically challenging and has a steep learning curve.⁷ Although some authors have championed this new approach, a recent randomized trial suggests that trabeculectomy is more effective in reducing intraocular pressure.⁸

In addition, there are continuing advances in medical therapy, conventional surgery and non-penetrating surgery.⁹ Good quality evidence comparing these potentially competing procedures with AquaFlow™ is not available.

The Evidence

No randomized controlled trials of the AquaFlow™ device have been published. Three published clinical studies (two prospective and one retrospective) were reviewed for this brief. In these, an intraocular pressure of less than 21 mm Hg,

without the use of medications, was used as the outcome measure for complete success. "Qualified success" was defined as an IOP < 21 mm Hg with glaucoma medications.

Sanchez et al. compared non-penetrating surgery, with (n=86 eyes) and without (n=82 eyes) collagen implants in individuals with medically uncontrolled POAG.¹⁰ After a mean follow-up of about nine months, IOP and visual acuity were similar between the groups. Although both groups had a decline in medication use, the decline was greater in the implant group (p=0.0038). The implant group had a greater complete success rate (~ 50% versus ~ 25%, p=0.0002) and a higher qualified success rate (~ 95% versus ~ 60%) at 18 months. A post-surgical complication, bleb fibrosis, occurred less frequently in the implant group (2% versus 11%, p=0.029).

Mermoud et al. compared non-penetrating glaucoma surgery using collagen implants (n=44) with conventional trabeculectomy (n=44) in individuals with medically uncontrolled POAG.⁵ After 24 months there was no significant difference in mean postoperative IOP. Non-penetrating surgery with the collagen implant resulted in vision returning earlier, fewer complications, a decreased need for glaucoma medications and a better complete success rate at 24 months (69% vs. 57%, p=0.046). There was no significant difference in qualified success rates. There was a 40% rate of conversion to conventional surgery in the first 10 non-penetrating procedures and a 3% conversion rate in the remaining procedures.

The study by Dahan et al. included 46 persons (86 eyes) with POAG and included both medically treated uncontrollable IOP (n=48 eyes) and untreated newly diagnosed cases (n=38) who had elected to have surgery as a first intervention.¹¹ The 'low-risk' group in their series (whites over the age of 45) had reduced IOP for longer (37 versus 19 months) than the high-risk group (Africans, Asians, Indians and whites younger than 45 yr). Also, previously untreated individuals experienced reduced intraocular pressure for longer than individuals who had received previous treatments (41 versus 23 months) and had lower re-operation rates (18% versus 85%). Some 33% of procedures were converted to conventional surgery in the first

six months, after which the conversion rate was 5%. With the caveat of a relatively small study population, this study suggests that early non-penetrating surgery may be more efficacious than delaying surgery until medical treatment has failed.

Results are not yet published from a multi-site U.S. prospective non-randomized clinical study that closed recruitment in September, 1999 and included approximately 200 patients.¹² All patients enrolled in the study will be examined postoperatively for a minimum of two years. Results from 125 patients with 12 months postoperative follow-up were presented at a recent conference. The efficacy of AquaFlow™ in reducing intraocular pressure was reported to be similar to trabeculectomy, but with significantly fewer serious complications.¹³

A randomized trial discussed at the same conference compared non-penetrating surgery with and without collagen implant in 104 patients (104 eyes) with medically uncontrolled primary and secondary open angle glaucoma. The group that received the implant showed a greater reduction in intraocular pressure at 48 months and a significant reduction in medication use.¹⁴

Implementation Issues

Non-penetrating surgery with the implantation of an AquaFlow™ device appears to be a relatively safe procedure in the hands of experienced surgeons. The technology has the potential to compete with conventional surgical procedures in the management of glaucoma, and may be a useful option for first line treatment of this condition in some individuals.

However, although AquaFlow™ shows promise in terms of its relative benefit compared to conventional surgery, its efficacy is not well established. Current published studies have methodological limitations, including non-randomized designs, small sample sizes, and relatively short follow-up periods. Also, given the additional cost of the device, cost-effectiveness needs to be established.

As this is a porcine implant, long-term data relating to potential adverse immunological and/or inflammatory effects are needed. There

may be possible ethical issues related to the use of this device in individuals whose faith prohibits the ingestion of pork.

The place of this technology relative to other recent developments in treatment of glaucoma may not emerge for some time.

References

1. Glaucoma treatment device wins FDA approval. **Med Ind Today** [serial online] 2001 Jul 17. Available: http://www.medicaldata.com/mit/printer_FRIENDLY_MIT.ASP?aRT=07170103 (accessed 2001 Jul).
2. Whitmore LA. **Understanding and living with glaucoma**. San Francisco: Glaucoma Research Foundation; 1999.
3. Elolia R, Stokes J. Monograph series on aging-related diseases: XI. Glaucoma. **Chronic Dis Can** 1998;19(4):157-69. Available: http://www.hc-sc.gc.ca/hpb/lcdc/publicat/cdic/cdic194/cd194d_e.html.
4. Boucher M. Glaucoma: keep a close eye on your patients. **Pharmacy Connects** [serial online] 2000 Feb. Available: <http://www.pharmacyconnects.com/content/phpractice/2000/02-00/php020002.html>.
5. Mermoud A, Schnyder CC, Sickenberg M, Chiou AG, Hédiguer SE, Faggioni R. Comparison of deep sclerectomy with collagen implant and trabeculectomy in open-angle glaucoma. **J Cataract Refract Surg** 1999;25(3):323-31.
6. Lerner SF. New approaches to glaucoma filtering surgery. **Ophthalmology Times** [serial online] 1999 Jun 15. Available: <http://www.glaucoma.net/nygri/education/publications/angle2.html>.
7. Carassa RG, Bettin P, Fiori M, Brancato R. Visco canalostomy: a pilot study. **Eur J Ophthalmol** 1998;8(2):57-61.
8. Jonescu-Cuypers C, Jacobi P, Konen W, Krieglstein G. Primary visco canalostomy versus trabeculectomy in white patients with open-angle glaucoma: A randomized clinical trial. **Ophthalmology** 2001;108(2):254-8.
9. Argento C, Sanseau AC, Badoza D, Casiraghi J. Deep sclerectomy with a collagen implant using the excimer laser. **J Cataract Refract Surg** 2001;27(4):504-6.
10. Sanchez E, Schnyder CC, Sickenberg M, Chiou AG, Hediguer SE, Mermoud A. Deep sclerectomy: results with and without collagen implant. **Int Ophthalmol** 1996;20(1-3):157-62.
11. Dahan E, Drusedau MU. Nonpenetrating filtration surgery for glaucoma: control by surgery only. **J Cataract Refract Surg** 2000;26(5):695-701.
12. Center for Devices and Radiological Health, Food and Drug Administration. **STAAR Surgical Company AquaFlow Collagen Glaucoma Drainage Device Model CGDD-20 P000026. Part 2: Summary of safety and effectiveness**. Rockville (MD): The Administration; 2001. Available: <http://www.fda.gov/cdrh/pdf/p000026.html> (accessed 2001 Jul).
13. Crandall A. Non-penetrating deep sclerectomy with the AquaFlow collagen glaucoma drainage device: results from the US FDA study [abstract]. In: Mermoud A, Shaarawy L, editors. **Proceedings of the First International Congress on Non-Penetrating Glaucoma Surgery 2001, Feb. 1-2, Lausanne Switzerland**. Lausanne: CHUV-Centre Hospitalier Universitaire Vaudois; 2001. p.59.
14. Shaarawy T, Nguyen C, Achache F, Schnyder CB, Mermoud A. Long term comparative results between deep sclerectomy with and without collagen implant [abstract]. In: Mermoud A, Shaarawy L, editors. **Proceedings of the First International Congress on Non-Penetrating Glaucoma Surgery 2001, Feb. 1-2, Lausanne Switzerland**. Lausanne: CHUV-Centre Hospitalier Universitaire Vaudois; 2001. p.63.

This brief was prepared by
Dr. Sandor Demeter, MD, MHSc, FACPM, FRCPC
and Dr. David Hailey, PhD (CCOHTA)
and has been peer reviewed.
The contents are current as of August, 2001.

For updates to the regulatory status of this
technology, check the sites in the Links
(Regulatory Status) section of our website:
www.ccohta.ca.

ISSN 1488-6324 (online)
ISSN 1488-6316 (printed)
Publications Agreement Number 40026386