SILICONE TUBE SHUNT IN SUPRACHOROIDAL SPACE IN RECALCITRANT GLAUCOMAS

Karki K J D¹, Momose A²

ABSTRACT

Silicone tube shunt operations to drain the aqueous from the anterior chamber to the suprachoroidal space were performed in 12 different types of refractory glaucomas in which the intraocular pressure ranged from 25 mmHg to 80 mmHg (mean 45.75 mmHg) even after maximally tolerated medical treatment or after conventional glaucoma surgery. The post-silicone tube shunt intraocular pressure ranged from 7 mmHg to 34 mmHg (mean 15.83 mmHg) after a follow-up period ranging 2 months in some cases to 24 months in others. The intraocular pressure was controlled in all cases postoperatively either with the operation alone or with medical treatment or after repeat operation. The complications were very few except in one case in which there was hyphema as well as vitreous hemorrhage prior to operation because of trauma for which pars plana vitrectomy followed by second silicone tube shunt operation were performed and at the end enucleation had to be done.

Key Words: Artificial Drainage, Shunt Operation, Recalcitrant Glaucomas.

INTRODUCTION

Recalcitrant glaucomas that is, glaucomas treated unsuccessfully either with maximally tolerated medical treatment or with conventional glaucoma surgeries have become a challenge to the ophthalmologic community for a long time. Before

being left to go atrophic either with uncontrolled intraocular pressure or phthisical with heroic cyclodestructive procedures the patients should have a better choice of controlling their intraocular pressure either to improve or maintain the vision or least of all to get rid of those nasty symptoms. Zorab¹ was the first to implant a seton in 1912.

1. Kathmandu Medical College, Sinamangal, Kathmandu, Nepal.

2. Institute of Clinical Ophthalmology, Kiryu, Gunma, Japan.

Address for correspondence : Dr. K. J. D. Karki
Senior Consultant
Dept. of Ophthalmology
Kathmandu Medical College, Sinamangal, Kathmandu

Molteno' deserves all the credit for arousing the interest in modern day ocular drainage implants. Krupin et al³ used valved implants to control the drainage of aqueous. Schocket et al⁴ increased the surface area for the diffusion of aqueous by putting the anterior chamber tube shunt to an encircling band. Later Krupin et al used a long tube and a 180° scleral explant. Even after such a long history of trials and tribulations of aqueous shunt operations the search for a better, cheaper material and a shorter, easier and effective method still goes on. Herein, we describe our experience with silicone tube shunt in suprachoroidal space in a prospective study carried out in the Institute of clinical ophthalmology, Kiryu, Gunma, Japan.

PATIENTS AND METHODS

The nature of the operation was discussed with the patient and informed consent obtained. The study included 12 different cases of recalcitrant glaucomas with uncontrolled intraocular pressure either with maximum tolerated single drug or multiple drugs medical treatment or after single or multiple conventional glaucoma surgeries or combined medical and surgical treatment.

The operation is done under peribulbar anesthesia. A 6-7 mm limbus based conjunctival

Fig. 1

Fig. 1 : Limbus Based Conjunctival Flap

Fig. 2

Fig. 2 : Half Thickness Scleral Flap

Fig. 3

Fig. 3 : Two Scleral Incisions and a Small Peripheral Iridectomy

flap with or without Tenon's capsule is dissected at either the upper nasal or upper temporal quadrant of the limbus. A quadrangular 4 x 4 mm half thickness scleral flap as in

Fig. 4

Fig. 4 : One End of Silicone Tube Inserted in Anterior Chamber and the other end inserted in Suprachoroidal Space

Fig. 5*Fig. 5 : The Tube Sutured to the Scleral Bed***Fig. 6***Fig. 6 : The Scleral Flap Sutured***Fig. 7***Fig. 7 : The Conjunctival Flap Sutured*

trabeculectomy is fashioned at the limbus and turned towards the cornea. Two ab externo incisions are made, one along the surgical limbus

and another at about 1 to 1.5 mm apart from the first incision. A small peripheral iridectomy is performed through the limbal incision. One end of a 5 mm long silicone tube with 1.0 mm outer diameter and 0.5 mm inner diameter is introduced into the anterior chamber through the limbal incision and another end of the tube into the suprachoroidal space through the second incision. The silicone tube in the anterior chamber is not long enough to touch the corneal endothelium. The silicone tube is sutured to the deep scleral bed with either 10-0 Prolene or Mersilene monofilament suture. The scleral flap is sutured water tightly with 9-0 PDS monofilament suture and the conjunctival flap is sutured with 7-0 catgut.

RESULTS

The cases varied in diagnosis as well as in age (range 18-81 years; mean 53.50 yrs) and sex (M:F=10:2). The follow-up period extended from 2 months to 24 months. The preoperative intraocular pressure ranged from 25 mmHg to 80 mmHg (mean 45.75 mmHg) and the post operative intraocular pressure ranged from 7 mmHg to 34 mmHg (mean 15.83 mmHg) either with postoperative medical treatment or with repeat silicone tube shunt operation (Table I).

The overall success with this operation alone was 66.66% and the remaining cases had intraocular pressure controlled with medical treatment or repeat shunt tube operation, the criteria for success rate as laid down in our objective being intraocular pressure 21 mmHg with or without medical and repeat surgical treatment with the improvement or retention of vision.

Table I : Silicone Tube Shunt Operation

No.	Age	Sex	Diagnosis	IOP before Op. mmHg	IOP after OP. mmHg
1	27	M	Juvenile Glaucoma (R)	61	7
2	79	M	Pseudophakic Traumatic Glaucoma (L)	80	12
3	41	M	Neovascular Glaucoma (R)	72	13
4	74	M	Uveitic Glaucoma after Triple Procedure (L)	32	20
5	76	M	Pseudophakic Neovascular Glaucoma (L)	57	18
6	81	F	PKP & Uveitic Glaucoma (L)	32	8
7	62	M	Aphakic Glaucoma (R)	25	15
8	18	M	Developmental Glaucoma (L)	40	34
9	33	M	Pseudophakic Uveitic Glaucoma (R)	40	18
10	67	F	PE Glaucoma (R)	33	18
11	24	M	Developmental Glaucoma (L)	29	7
12	60	M	High Myopia with Open Angle Glaucoma (L)	48	20
			Mean IOP	45.75 mmHg	15.83 mmHg

DISCUSSION

Ocular drainage implants known in ophthalmic terminology as setons were tried to facilitate drainage of the aqueous humour from the anterior chamber into the subconjunctival and orbital spaces. The first perilimbal shunt coined 'Aqueoplasty' by Zorab was a silk thread drawn through a wound to create a tract or fistula between the anterior chamber and the subconjunctival space perilimbally. As this opened a door for the pioneers in this field, they tried to improve the materials as well as methods to shunt the aqueous away from the anterior chamber to a suitable site so that the intraocular pressure of a recalcitrant glaucoma could be lowered without any serious complication. The material has gone through a series of tests and trials so that a material which does not cause fibrosis around the distal end and block the aqueous from the anterior chamber could be found. The materials varied from gold, tantalum, glass, platinum, horsehair, plastics, silicone strip, autologous lacrimal gel film, canaliculus, to valved tubes.⁶⁻¹⁵ These different types of setons resulted in

low success rate because of fibrosis around the outer end of the tube which prevented aqueous draining into subconjunctival tissue.¹⁶⁻¹⁷ To prevent fibrosis biologically inert materials were searched upon and translimbal shunts were designed.^{2,3,16} The problem of limited surface area for the diffusion of aqueous around the distal end of the shunt, was still there. However, this problem could be avoided by placing the distal end of the shunt tube either on a plate or an encircling band to create a reservoir and then placing it over the equatorial region of the sclera.^{4,5,15,19} Molteno in 1969 designed an implant that consisted of a silicone rubber tube attached to a thin circular episcleral polymethylmethacrylate plate located at the perilimbal area. Later, he redesigned the implant by enlarging the tube and plate and placing it posterior to the rectus muscle insertions on the equatorial region. There are single plate and double plate Molteno implants available.

These modified Molteno implants have improved results and proved successful in many cases of refractory glaucomas. The surgical success rates with the Molteno implants in complicated glaucomas

have varied.²⁰⁻²² The highest 5 year life-table surgical success rate achieved after one plate in the updated study was in patients with aphakic/pseudophakic glaucoma (46%), followed by those with glaucoma in childhood (26%), glaucoma's with failed filters (25%) and patients with neovascular glaucoma 25%. The placement of a second plate increased the success rate²¹ to 53%, 71%, 40% and 56% in patients with aphakic/pseudophakic glaucomas, those with failed filters, those with neovascular glaucoma's and those with glaucomas who were less than 13 years of age respectively.

To increase the surface area for diffusion of aqueous fluid, anterior chamber tube shunt to an encircling band (ACTSEB) procedure was first described in 1982. The reported success rates have varied with intraocular pressure control in 71% of eyes in unresponsive patients with an ACTSEB device.²³

Initially, Krupin-Denner device had a short perilimbal seton of a supramid tube sealed to a silicone rubber tube with a slit like valve. They modified it and added a long tube to the valve and drained the aqueous equatorially. Krupin et al reported intraocular pressure control in 68% of eyes with neovascular glaucoma. These different types of aqueous drainage implants have significant differences in their physical construction but they employ the same basic principle of draining aqueous from the anterior chamber to the equatorial region translimbally. The Molteno implant procedure is the easiest to perform but the Schochet system is the least expensive. However the Molteno implant produced a statistically lower IOP at 6 months compared with the Schochet shunt.²⁴ Hasan et al compared the effectiveness of glaucoma control between two drainage implants, the Baerveldt Model 350 and the Ahmed glaucoma valve (AGV), in patients with refractory glaucoma. They concluded that there is no significant advantage in glaucoma control over a 1-year period following surgery.²⁵

The complications were similar in variety and nature in all these aqueous shunt operations. They included hyphema, hypotony, flat anterior chamber, corneal decompensation, Cataract., uveitis, Tenon's cyst, blocked tube, erosion of the tube and plate, choroidal detachment, retinal detachment and phthisis bulbi.

The material in the study is a simple silicone tube easily available everywhere. The operation is easy and takes a very short time to perform as this procedure does not need dissection to reach the equatorial region. The supra-choroidal space is a very large potential space for the diffusion of the aqueous and it should not be created by dissection. Moreover, the fibrous capsule formation and thereby blockage of the distal end of the shunt tubes as noticed in other procedures are not present in this procedure. The operation is performed in one stage and it can be repeated at the other quadrant of the limbus if the first operation does not control IOP. The complications like hypotony, hyphema, corneal decompensation, iritis, cataract and choroidal detachment were not noticed. The encouragement to explore this potential space to shunt the aqueous from the anterior chamber comes from the trabeculocyclostomy or trabeculostomy procedure by which the IOP is controlled and the choroidal detachment which is the most dreaded complication was never noticed.²⁵ The chances of shunt tube erosion and late infection are absent as the tubes are put in a closed space. The parameters of success and failures of such types of operations are as varied as the diagnosis, age, sex and condition in which the operation is performed.

CONCLUSION

Looking at the complexities of recalcitrant glaucomas in which the silicone tube shunt operations were performed, being the easiest, cheapest and shortest operation without any serious complication that was expected therefrom and

comparing the success rates of percentage from other shunt operations the silicon tube shunt operation in suprachoroidal space needs serious consideration, thought and future study.

REFERENCES

1. Zorob A : The reduction of tension in chronic glaucoma. *Ophthalmoscope* 1912, 10:258-261.
2. Molteno ACB : New implant for drainage in glaucoma. *Br J Ophthalmol* 1969. 53:606-615.
3. Krupin T, Kaufman O, Mandel A, et al Filtering valve implant surgery for eyes with neovascular glaucoma. *Am J Ophthalmol* 1980, 89: 338-343.
4. Schocket SS, Lakhnpal V. Richards RD : Anterior chamber tube shunt to an encircling band in the treatment of neovascular glaucoma. *Ophthalmology* 1982, 89:1188-1194.
5. Krupin T, Ritch R, Camras CB et al : A long Krupin-Denner valve implant attached to a 1800 scleral explant for glaucoma surgery. *Ophthalmology* 1988. 95: 1174-1180.
6. Stefannson J : An operation for glaucoma. *Am J Ophthalmol* 1925, 8:681-693.
7. Wolfe WO. Blaess MJ : Seton operation in glaucoma. *Am J Ophthalmol* 1936, 3 :400-406.
8. Blaess MJ : A further report on the seton operation for glaucoma.. *Am J Ophthalmol* 1938, 3:865-870.
9. Bick MW : Use of tantalum for ocular drainage. *Arch Ophthalmol* 1949, 42: 373—388.
10. Bock RN Subconjunctival drainage of the anterior chamber by a glass seton. *Am J Ophthalmol* 1950, 33:929-933
11. Parry TGW : Tantalum drain in glaucoma. *Br J Ophthalmol* 1950. 34:684-687.
12. Stone W : Alloplasty in surgery of the eye. *N Engl J Med*, 1958. 258:486-490.
13. Lehman RN. McCaslin MF : Gelatin film used as a seton in glaucoma. *Am J Ophthalmol* 1959, 47:690.
14. Gibson GG : Transcleral lacrimal canaliculus transplants. *Am J Ophthalmol* 1944, 27:258-269.
15. Ellis RA : Reduction of intraocular pressure using plastics in surgery. *Am J Ophthalmol* 1960, 50:773.
16. Richards RD. Van Bisterveld OP : Artificial drainage tubes for glaucoma. *Am .1 Ophthalmol* 1965, 60:405-408.
17. EpsteinE : Fibrosing response to aqueous. *Br J Ophthalmol* 1959, 43:641-647.
18. Molteno ACB, Straughan JL, Ancker E : Long tube implants in the management of glaucoma. *S Afr Med J* 1976, 50:1062.
19. Molteno ACB : The optimal design of drainage implants for glaucoma. *Trans Ophthalmol Soc NZ* 1981. 33:39-41.
20. Downess RN, Clanagan DW, Jordan K, Burton RL : The molteno implant in untractable glaucoma. *Eye* 1988, 2: 250.
- 21.. Lloyd MA. Sedlak T. Dale K, et al : Clinical Experience with the single-plate Molteno Implant in complicated Glaucomas - A Update of a pilot study. *Ophthalmology* 1992, 99:679-687.
22. Freedman J, Rubin B : Molteno implants as a treatment for refractory glaucomas in black patients. *Arch Ophthalmol* 1991, 109:1417-1420.
23. Hihchings RA, Lattimer J : How to manage the unresponsive patient. *Eye* 1987, 1:55.
24. Wilson RP, Cantor L, Katz LZ et al : Aqueous shunt, Molteno versus Schocket, *Ophthalmology* 1992, 99:672-678.
25. Hasan M. Syed, Simon Law M.D. at el : Baerveldt Model 350 implant vs Ahmed Glaucoma valve for refractory Glaucoma : A case match comparison STTP Abstracts on line – Summer 2001.