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Original Article

Long term comparison between single stage Baerveldt and Ahmed glaucoma implants in pediatric glaucoma

Nehal M.S. El Gendy, MBBch, MD [a,b]; Jonathan C. Song, MD [a,c,*]

Abstract

Purpose: To compare the long term intraocular pressure control in pediatric glaucoma patients who underwent single stage Baerveldt glaucoma valve and Ahmed glaucoma valve S2 implantation.
Study design: A retrospective study was conducted to analyze the data of patients with single stage Baerveldt glaucoma valve and Ahmed valve implantation at Children Hospital Los Angeles.
Methods: Medical records of patients were reviewed retrospectively and divided into two groups. All cases received single stage valve implantation in which the tube was inserted primarily into the anterior chamber. In cases with Baerveldt implants, the silicone tube was ligated near its plate location with a single absorbable suture. Group 1 included patients with Baerveldt glaucoma implant model BG 101–350, while group 2 included patients with Ahmed valve implant model S-2. Patients' data collected ranged over the period from 2001 to 2008. The minimum follow up period was 6 month; maximum follow up period was 8 years. All patients were below 18 years of age. Success was considered if last postoperative IOP was between 8 and 24 mm Hg (with or without medications), no additional glaucoma surgery after valve implantation, and absence of visually significant complications.
Results: Group 1 included 20 cases and group 2 included 11 cases. Long term success rate based on criterion defined was 80% for group 1 (Baerveldt) with average IOP postoperatively on last follow-up of 19.6 mm Hg. In group 2 (Ahmed), average postoperative pressure was 24 mm Hg with 6 out of 11 considered successful based on criterion giving 54.5% success rate.
Conclusion: In the long term, single stage Baerveldt implantation appears to control pressure well in pediatric glaucoma.

Keywords: Ahmed implant, Baerveldt implant, Comparison, Glaucoma valve, Pediatric, Glaucoma

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Introduction

Pediatric glaucoma is a potentially blinding disease. Treatment options remain mainly surgical. Mild cases are treated primarily by goniotomy and or trabeculotomy, if angle cannot be visualized. Success rate up to 77% for congenital/infantile glaucoma have been reported. In cases were both goniotomy and trabeculotomy fail treatment options become limited and challenging which include, trabeculectomy, cyclodestructive procedure, and valve implantation.[1,2]

Trabeculectomy without antifibrotic agent had been associated with a variable rate of success ranging from 37% to 85%.[3–10] This widely variable rate of success has limited the predictability of such procedure in pediatric glaucoma. The addition of antifibrotic agents such as mitomycin C to trabeculectomy procedure has been associated with short term

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[a] Childrens Hospital Los Angeles, University of Southern California, USA
[b] Department of Ophthalmology, Cairo University, Cairo, Egypt
[c] Department of Ophthalmology, King Khaled Eye Specialist Hospital, Riyadh, Saudi Arabia

* Corresponding author. Address: Pediatric Ophthalmology Division, King Khaled Eye Specialist Hospital, PO Box 7191, Riyadh 11462, Saudi Arabia. Tel.: +966 1 4821234x3858; fax: +966 1 4821234x3727.
e-mail addresses: jsong@kkesh.med.sa, jsong41@jhmi.edu (J.C. Song).

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success rate ranging from 67% to 100%.[11,12] However, long term serious complications such as bleb leakage and infections have been a worrisome factor. Cyclodestructive procedure has been limited by the higher incidence of phthisis bulbi.[13,14] Aqueous drainage devices were first suggested by Molteno in 1973, with a success rate of 67%.[15] More recently, popular used glaucoma valves include the Ahmed valve and Baerveldt glaucoma valve.

In our study we evaluated the long term outcome as regards to intraocular pressure control (IOP), need of further surgeries and success rate of patients less than 18 years with single stage Baerveldt valve implantations as compared to Ahmed glaucoma valve implantation.

Methods

The study was registered with the institutional review board (IRB) and was approved by ethics committee of the institution.

Preoperative data collected

Data obtained from chart review included age at surgery, glaucoma etiology, associated ocular or systemic diseases, highest IOP recorded preoperative (despite of medications), number of anti-glaucoma medications used, and previous operations.

Operative details

All cases were done under general anesthesia; intraocular pressure (IOP), cup to disc ratio (C/D), and slit lamp examination were done in all patients after induction of anesthesia.

All patients were prepped and draped in usual sterile manner. Lid speculum was applied. 6-0 vicryl corneal retraction suture is placed at 12 o'clock to allow for exposure of the superior temporal quadrant. Conjunctival incision 7–8 mm from the limbus was made, and then released both medially and temporally; tenon layer was elevated and cut down to bare sclera. Anterior dissection into clear corneal, limbal junction was made. Posterior dissection is made to reveal the superior temporal quadrant and bare sclera. In 20 cases, Baerveldt implant model BG 101–350 was implanted. The tube was flushed first with BSS to ensure its patency. The wings of the implant were inserted one under the superior rectus the other under the lateral rectus. The implant was fixed using two 8-0 nylon sutures 9 mm from the limbus. The sutures were rotated to bury the knot. 6-0 vicryl suture was placed to tie of the tube to prevent flow near its site of insertion to the plate. The tube was then trimmed to size and a 23 gauge needle was used to enter the anterior chamber, tube was inserted into anterior chamber. Tube fenestration was made and a sclera patch graft was then applied to cover the anterior portion of the tube. Tenon and conjunctiva were then closed using 8-0 vicryl BV sutures in continuous manner.

Eleven cases were implanted with Ahmed valve model S-2, the technique followed similar steps to that of Baerveldt. Rectus muscle did not need to be isolated. Ligation of the tube and fenestration was not needed given the valved nature of this implant. In all cases subconjunctival antibiotic and steroid were given and a light patch was applied.

Postoperative data collected

Included 6 month, 1 year and last visit postoperative IOP, total duration of follow up, number of medications used, reoperations. Success was defined as IOP between 8 and 24, no further glaucoma surgeries indicated, and absence of vision threatening complications.

Data analysis

Results are given as mean + SD with range indicated. Statistical comparisons were performed using paired sample *t* tests. *P* value less than 0.05 was considered statistically significant.

Results

Patients were divided into two groups, group 1 (Baerveldt implant BG 101 model 350) and group 2 (Ahmed valve implant model S-2).

Group 1 included 20 cases, 12 cases were congenital glaucoma, 8 cases were secondary glaucoma (4 aphakic glaucoma, 1 neovascular glaucoma, 1 congenital hereditary endothelia dystrophy (CHED), 1 aniridia, and 1 steroid induced glaucoma. Nine cases were associated with other ocular diseases (aniridia, sturge weber, pars planitis, ocular rubella, CHED, ROP (retinopathy of prematurity), PHPV (persistent hypertrophic primary vitreous), and microphthalmia) while two cases were associated with systemic diseases (mental retardation and intra-uterine rubella infection). Age ranged from 6 month to 18 years of age (average 5.4 years). Average preoperative highest recorded IOP was 33.8 ± 5.7 mm Hg using tonopen. Average numbers of medications were 2.3 ± 1.1 used preoperatively. Average preoperative C/D ratio was 0.8 ± 0.2. Average age at surgery was 5.4 ± 5.1 years. Average IOP 6 month postoperative was 17.4 ± 8.2 mm Hg; 1 year postoperative was 19 ± 6.9 mm Hg. Total follow up period ranged from 1 to 6 years in group one with average of 3.8 ± 2.4 years. Average IOP in last postoperative visit was 18 ± 5.7 mm Hg on average number of anti-glaucoma medications of 1.5 ± 1.2, C/D ratio of 0.6 ± 0.2. Average age at last follow up was 9.5 years (range 2–19 years). Four cases out of twenty were considered unsuccessful according to criteria mentioned above (80% success rate for group 1).

Demographic data of group 1 are summarized in Table 1.

Group 2 included 11 cases, 5 cases were congenital glaucoma, 6 cases were secondary glaucoma (1 aphakic glaucoma, 2 anterior segment dysgenesis, 2 uveitis, 1 with iridocorneal endothelial syndrome). Six cases were associated with other ocular diseases, while no cases were associated with systemic diseases. Age ranged from 7 month to 17 years of age (average 6.7 years). See Table 2. Average preoperative highest recorded IOP was 39.8 ± 6.2 mm Hg using tonopen. Average numbers of medications were 2.7 ± 1.9 medications used preoperatively. Average preoperative C/D ratio was 0.75 ± 0.1. Average IOP 6 month postoperative was 19.6 ± 6.1 mm Hg; 1 year postoperative was 24 ± 5.4 mm Hg. Total follow up period ranged from 6 month to 7.5 years with average of 2.7 ± 2.5 years. Average IOP in last postoperative visit was 24 ± 8.7 mm Hg on an average number of anti-glaucoma medications of

Table 1. Demographic data of group 1.

Study number	Date of birth	Sex	Diagnosis	Associated ocular disease	Associated systemic disease	Age at surgery
1	12/27/1992	m	lt aniridia	Yes	No	10
2	10/28/2000	m	lt congenital	Yes	No	2
3	4/19/1984	f	lt congenital	No	No	18
4	10/27/1992	m	rt NVG	Yes	No	10
5	11/30/1998	f	lt aphakic glaucoma	No	No	3
6	8/10/1990	m	lt CHED	Yes	Yes	11
7	9/22/2005	m	rt congenital	No	No	0.5
8	1/20/2004	f	rt aphakic glaucoma	No	No	2
9	4/12/2004	f	rt aphakic glaucoma	Yes	No	1.3
10	3/20/1997	f	lt congenital	Yes	No	7
11	3/4/1992	f	lt aphakic glaucoma	Yes	Yes	12
12	6/5/1995	m	lt congenital	No	No	9
13	4/21/2003	f	rt congenital	No	No	0.7
14	4/21/2003	f	lt congenital	No	No	0.75
15	1/20/2000	m	lt congenital	No	No	3
16	3/28/2001	m	lt congenital glaucoma	No	No	7
17	3/28/2001	m	rt congenital	No	No	7
18	9/10/2007	m	rt steroid induced	Yes	Yes	1.3
19	10/6/2007	m	lt congenital	No	No	0.75
20	1/25/2003	m	lt congenital	No	No	1.5

f = female, m = male, nr = no record, rt = right, lt = left, NVG = neovascular glaucoma, CHED = congenital hereditary endothelial dystrophy.

Table 2. Demographic data of group 2.

Study number	Date of birth	Sex	Diagnosis	Associated ocular diseases	Associated systemic disease	Age at surgery
1	10/21/1999	f	lt congenital glaucoma	No	No	nr
2	12/3/1996	f	lt congenital glaucoma	Yes	No	4
3	7/23/1996	m	rt secondary glaucoma	Yes	No	4
4	8/19/1997	m	rt secondary glaucoma	Yes	No	8
5	7/25/1998	m	lt congenital glaucoma	No	No	2
6	6/6/1997	m	lt congenital glaucoma	No	No	2.5
7	10/15/1999	f	rt secondary glaucoma	Yes	No	6
8	10/15/1999	f	lt secondary	Yes	No	9
9	10/18/1986	f	lt secondary	Yes	No	14
10	4/15/1982	f	rt secondary glaucoma	Yes	No	17
11	3/25/2002	f	lt congenital glaucoma	No	No	0.56

f = female, m = male, nr = no record, rt = right, lt = left.

2.3 ± 1.7. Average postoperative C/D ratio was 0.6 ± 0.1. Average age at last follow up was 9.7 ± 6.2 years (range 2.5–21.5 years. Five cases out of 11 were considered unsuccessful according to criteria mentioned above (54.5% success rate for group 2).

Number of congenital glaucoma was comparable in the two groups, 12 cases out of 20 cases group one (60%), 5 cases out of 11 cases (45.5%) group 2. The mean age in both groups was 5.3 years Group 1, 6 years group 2; the difference was statistically not significant $P = 0.7$. The maximum preoperative IOP measurement difference between the two groups was statistically significant $P = 0.02$.

Difference between postoperative follow up period was statistically not significant $P = 0.3$ with longer average postoperative follow up period for Group 1.

Postoperative last visit IOP was higher for Group 2 (24 mm Hg) compared to Group 1 (17.4) and the difference between the two groups was statistically significant $P = 0.03$. Average number of medication needed postoperatively was more for Group 2, the difference was statistically not significant $P = 0.14$.

Discussion

Although glaucoma drainage implants have been used since 1970[16], success rate has been very controversial with minimal data about long term success rate and preferred type of implants for pediatric glaucoma. We compared the results of the two more commonly used pediatric glaucoma implants, Baerveldt and Ahmed implants, done by the same surgeon over a period of time.

Previous studies have demonstrated that greater implant surface area is associated with a greater lowering of IOP; however, this theory remains controversial.[17,18] Baerveldt implant model 350 has a wider implant surface area than Ahmed valve. A study by De Moura et al., in 2005 [19] showed no significant difference between the success rate of Baerveldt implants 350 mm^2 and 500 mm^2. In our study, only Baerveldt implant 350 mm^2 was used.

Success rate of Ahmed valve implants in children has been varied. In a study by Englert et al.[20] in 1999, the success rate of Ahmed used in patients younger than age 18 years was 85.2% at last follow-up. In our study, Ahmed valve success rate was 54.5%, however, in Englert's study follow up was mainly for 3 month, in our study follow up period ranged from 6 months to 7.5 years (average 2.7 years). Morad et al., using the Ahmed implant in 44 patients, reported decreasing success rate with time; 93% at 1 year, 86% at 2 years, 71% at 3 years, and 45% at 4 years. [21]

Baerveldt implant has been used in pediatric glaucoma, In De Moura's study, success rate was 77.1%[19], compared to our results (80%). It should be noted that in De Moura's

study, some cases received Baerveldt implant as the primary line of treatment. In the study when comparing single-stage and two-stage implantation, there was no difference in the probability of success (success, single stage in 20 [71%] of 28 eyes; success, two-stage in 17 [85%] of 20 eyes; $P = .32$), nor did the location of the tube result in different probabilities of success (anterior chamber successful in 24 [71%] of 34 eyes; posterior chamber successful in 11 [79%] of 14 eyes; $P = 1.00$). In our study, all cases underwent single stage surgery, three cases had pars plana tube insertion; the three cases met the criteria of success. No specific complications were associated with single stage Baerveldt implantation with absorbable suture ligation.

The success rate of glaucoma implant surgery in our study was comparable with previous studies. Baerveldt implant success rate was higher than Ahmed valve success rate in our study, with lower postoperative IOP, and lower number of postoperative medications needed to maintain a suitable IOP. The number size and retrospective nature of this study have their limitations. The two sample groups were not as homogeneous and may be the reason why the final IOP in group 2 was higher. We also defined success rate as pressure of 24 or lower in our study which is different from previous studies. This was done given that many of our last pressure in these children were obtained with the child awake. Due to the child's degree of cooperativeness higher pressures may be seen in these children. Pressure of 24 or below as what was used by the treating physician in which the child was considered stable at the time, with no medications added and no additional surgery needed. In addition, with new model of Ahmed implant FP7, pressure control and healing characteristics in the long term may be different as compared to Ahmed S2 model. Future studies of interest include a prospective randomized study of different implants that are available in treatment of pediatric glaucoma. Due to these reasons, we cannot conclude whether or not one implant is better than the other; however, we can conclude that a single stage Baerveldt implant can be a successful, safe method for treatment of intractable glaucoma in children.

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