Original Article

A new surgical technique of intra-scleral tube fixation in Ahmed Glaucoma Valve implantation ‘Scleral Sleeve Method’

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Abstract

Purpose: To present a new surgical technique ‘Scleral Sleeve Method’ which would reduce the risk of Ahmed Glaucoma Valve (AGV) tube related complications in patients undergoing AGV FP7 (New World Medical Inc., Rancho Cucamonga, CA) for refractory glaucoma.

Design: Prospective, Non-Randomized, hospital based interventional case series.

Subjects: A total of 16 eyes of adult patients (10 males and 6 females) with refractory glaucoma.

Methods: Instead of using sutures to fix the AGV tube to sclera, we devised a novel method of intra-scleral tube fixation by creating a scleral tunnel fashioned in form of sleeve.

Main outcome measure: Post-operative tube related complications.

Result: There were no tube related complications such as exposure, extrusion or retraction in any of the cases.

Conclusion: Use of scleral sleeve method for tube fixation, along with graft to cover the tube, will provide additional safety measure and reduce the risks of tube related complications.

Keywords: Ahmed Glaucoma Valve, Scleral Sleeve Method, Intra-scleral tube fixation

Introduction

Ahmed Glaucoma Valve (AGV) is being used since 1995 for surgical management of refractory glaucoma. In the commonly used model (FP7), the tube, which drains aqueous from anterior chamber to the plate is made of silicone. Tube is usually covered with donor scleral patch graft, which is sutured to the surrounding sclera and holds tube in position. Tube is also fixed to sclera using non-absorbable sutures. In spite of this, tube related complications such as exposure, extrusion and migration are known to occur. Tube exposure is a well-known complication occurring in around 1% of AGV implant surgeries. We present a new method of intra-scleral tube fixation using scleral tunnel fashioned in form of sleeve, which along with graft will provide additional secure mechanism against complications.

Materials and methods

Prospective, Non-Randomized, hospital based interventional case series. A total of 16 eyes of adult patients with refractory glaucoma were included. All patients underwent AGV implantation with the Scleral Sleeve Method by a single surgeon (CK). Patients having completed at least 6 months of follow-up post-operative were included in the series. Complete eye evaluation was done with documentation of anterior and posterior segment findings. Pre-operative and post-operative IOP measurements were done. Tube related...
complications were looked for at each follow-up. IOP of ≤5 mmHg and ≥21 mmHg was considered as failure. Follow-ups were done on days 1, 7, 30, 90, and 180 and continued every 3 months thereafter. Patients were instructed to report back in case of any unusual symptoms. Prior informed consents were obtained in all patients and Institutional review board clearance was obtained. The study adhered to the tenets of the Declaration of Helsinki.

**Surgical technique: (Video: Clip 1)**

The initial steps are similar to those done routinely for AGV implantation. After performing fornix based peritomy, pocket is created between tenon’s capsule and sclera by blunt dissection using Westcott’s scissors in the quadrant designated for implant. AGV implant is primed before insertion using saline via 30 gauge cannula. The primed implant is then placed in the subtenon’s pocket making sure the plate is not held during insertion to prevent damage to valve. The eyelets are placed at least 8 mm from limbus and the implant is then sutured to the sclera with non-absorbable sutures (8-0 silk).

The path of tube towards limbus is marked with marker pen. This is to ensure that the final path of tube is in a straight line to prevent tube kinking. Scleral tunnel margins are marked approximately 2 mm from the implant on the marked path of tube. A crescent blade or a hockey stick knife is used to create a partial thickness scleral sleeve. The width of sleeve should be at least 1 mm and length 2 mm (Fig. 1a). The depth of dissection should be limited to 1/3rd scleral thickness so as to prevent inadvertent scleral perforation.

Tube is passed under the fashioned intra-scleral sleeve (Fig. 1a). Instead of using preserved donor scleral patch graft, we dissect limbal based partial thickness scleral flap (5 mm by 3 mm) at limbus to cover the tube before it enters the anterior chamber. 22 gauge needle is used to make entry into anterior chamber below the scleral flap. After trimming the tube to appropriate length with the end being bevel up, it is positioned in the anterior chamber passing through the 22 G needle entry track. Partial thickness scleral flap is sutured with 10-0 nylon (Fig. 1b). Implant is covered with conjunctiva and tenon’s capsule. Finally conjunctiva is sutured with 8-0 vicryl suture.

**Results**

Out of the 16 patients, 10 were males and 6 were females and the average age was 50.13 (CI at 2SD was 36.34–63.92) years. Out of the 16 cases, most common indication was neovascular glaucoma (7 eyes). (Table 1) AGV implantation with ‘Scleral Sleeve Method’ to anchor the tube was done in all cases. Minimum follow-up of 6 months was considered [mean follow-up duration: 20.93 months (CI at 2 SD was 12.18–29.68)]. There was no case of tube exposure or extrusion in our series. At 6 months, 5 (31.25%) cases had IOP < 21 mmHg without additional anti glaucoma medications (AGM), and 10 (62.5%) cases required additional AGM and 1 (6.25%) patient had failure. (Table 1) Mean pre-treatment IOP was 36.94 mm of Hg (95% CI: 32.46–41.41) which got reduced to a mean IOP of 16.56 mm of Hg (95% CI: 14.0–19.12) post-operatively. Unpaired t test was used to measure level of significance. The two tailed p value was found to be <0.0001 which was highly significant.

**Discussion**

The five year follow-up results of ABC study demonstrated 1% risk of tube exposure in AGV implants.¹ Various materials are used to cover tube such as donor sclera, pericardium, dura, fascia lata or autologous patch graft.²⁻⁴ In spite of placing graft to cover tube, immunological and mechanical mechanisms lead to graft thinning and tube erosion.⁵,⁶ Tube erosions are usually managed with placement of additional grafts but in severe cases may require glaucoma valve explanation.⁷

Use of scleral sleeve method for tube fixation, along with graft to cover the tube, will provide additional safety measure over traditional methods. Though in our case series the follow-up period was of only 6 months, there was no tube exposure or extrusion. There was 1 case of tube opening block by iris which was successfully treated with YAG laser.

Fixing the tube to sclera with sutures is associated with risks of complications. Sutures, over a period of time, can break, loosen or erode. During passage of needle, there is always a small risk of scleral perforation. These suture related complications are overcome by this suture free technique.
Fashioning scleral sleeve by creating tunnel using crescent blade or hockey stick knife is safe, as posterior surface of the blade is flat, eliminating chances of accidental perforation. Moreover during this procedure, the blade is always visible through sclera, ensuring safety and proper plane of dissection. None of our cases had any scleral complications during creation of scleral sleeve.

In our experience this size of scleral sleeve (2 mm by 1 mm) is adequate for smooth tube passage without risk of compression. There is no risk of suture-knot exposure related complications such as conjunctival erosion or graft melt. Even in patients with thin tenon’s capsule or thin conjunctiva, scleral sleeve would keep the tube well tucked. This technique may prove to be superior in cases where conjunctiva is compromised and more likely to erode like in patients who underwent multiple surgeries, use of anti-fibrotic agents and post-uveitis patients. Conjunctival erosion from any cause is a known risk factor for endophthalmitis in glaucoma drainage implants. Our series did not have any conjunctival erosion.

Tube exposure is known to increase risk of endophthalmitis. Reducing risk of tube exposure with our technique would also decrease the risk of endophthalmitis. Use of preserved scleral patch graft, if not sutured properly or if too thick, can lead to conjunctival micro-trauma and erosion due to constant lid rubbing on elevated surface. With a tube well fixed in intra-scleral manner, there is less chance of tube displacement in event of minor trauma or vigorous eye rubbing. Tube retraction is a known to occur even without inciting events.

Due to proper fit, this technique also reduces the risks of lateral movement of tube which otherwise can contribute to micro-movements of implant. Micro-movements have been postulated to contribute to bleb failure by inducing inflammation and fibrosis. The absence of control group and lack of long-term follow-up data are limitations of our study.

Conclusion

Use of Scleral sleeve method for tube fixation, along with graft to cover the tube, will reduce the risk of tube exposure, extrusion and migration and related complications such as endophthalmitis. It will also bring down suture related complications. Larger studies and longer follow-up periods are required to confirm our findings regarding this new technique. Whether this technique also reduces the micro-movements of the implant, needs to be evaluated further.

Conflict of interest

Authors declare that there is no conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.sjopt.2017.04.002.

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Table 1. Clinical characteristics of patients undergoing AGV with Scleral Sleeve Method.

| S. No. | Age | Gender | Indication | Pre-surgery IOP (mmHg) | IOP at last follow-up (with AGM) | Number of AGM at last follow-up | Duration of follow-up (months) | Tube related complication/conjunctival erosion |
|--------|-----|--------|------------|------------------------|-----------------------------------|-------------------------------|--------------------------------|-----------------------------------------------|
| 1      | 65  | F      | NVG        | 42                     | 18                                | 3                             | 15                              | None                                          |
| 2      | 47  | M      | NVG        | 47                     | 20                                | 2                             | 12                              | None                                          |
| 3      | 24  | F      | Post-uveitic trab | 28                     | 16                                | 1                             | 24                              | None                                          |
| 4      | 57  | F      | Failed trab | 33                     | 14                                | 0                             | 8                               | None                                          |
| 5      | 71  | M      | NVG        | 36                     | 18                                | 0                             | 30                              | None                                          |
| 6      | 52  | M      | Post-uveitic trab | 35                     | 19                                | 2                             | 29                              | None                                          |
| 7      | 28  | M      | Post-traumatic trab | 26                     | 12                                | 1                             | 30                              | None                                          |
| 8      | 41  | F      | Post-uveitic NVG | 40                     | 17                                | 2                             | 18                              | None                                          |
| 9      | 65  | M      | NVG        | 50                     | 32                                | 3                             | 20                              | None                                          |
| 10     | 62  | F      | NVG        | 52                     | 14                                | 0                             | 16                              | None                                          |
| 11     | 43  | M      | Post-PK    | 33                     | 12                                | 2                             | 24                              | None                                          |
| 12     | 47  | M      | Failed trab | 26                     | 14                                | 0                             | 26                              | None                                          |
| 13     | 55  | M      | NVG        | 44                     | 16                                | 0                             | 12                              | None                                          |
| 14     | 62  | M      | Failed trab | 29                     | 16                                | 1                             | 11                              | None                                          |
| 15     | 50  | F      | NVG        | 40                     | 12                                | 2                             | 36                              | Tube opening block by iris                   |
| 16     | 33  | M      | Post-traumatic trab | 30                     | 15                                | 1                             | 18                              | None                                          |

M: Male, F: Female.
AGV: Ahmed Glaucoma Valve, AGM: Anti-Glaucoma Medication.
NVG: Neovascular Glaucoma, PK: Penetrating Keratoplasty, TRAB: Trabeculectomy.
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