International Journal of Research Studies in Medical and Health Sciences
Volume 4, Issue 6, 2019, PP 01-05
ISSN : 2456-6373

A Treatment of Refractory Glaucoma in Pseudophakic Patients after Posterior Vitrectomy using the Ahmed Valve in an Own Modification

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ABSTRACT

An article describes technique and results of Ahmed valve implantation in patients with refractory glaucoma, in an own modification. An anterior-chamber model of the Ahmed valve or models designed to the vitreous cavity were used. An adapter from valve to vitreous cavity was removed before introducing it into vitreous chamber. A reduction and stabilization of the intraocular pressure were obtained over the 6-month follow-up period. Using this modification which gives valuable benefits: economic, reduction of intraocular pressure and minimizing the incidence of postoperative complications.

Keywords: *refractory glaucoma, Ahmed valve, posterior vitrectomy, pseudophakia.*

INTRODUCTION

Refractory glaucoma (RG) is the most severe type of secondary glaucoma. It comprises the cases of neovascular glaucoma, usually found in patients with ocular complications of diabetes mellitus and untreated ischemic central retinal vein occlusion [1]. Other causes of refractory glaucoma include states post congenital glaucoma surgery and pars plana vitrectomy with silicone oil infusion, recurrent uveitis, as well as past trauma [2].

In extreme RG cases, the aqueous outflow through the drainage angle of the eye is completely obstructed. This state produces a significant increase in intraocular pressure (IOP), reaching the levels of 40-70 mmHg.

The choice of a treatment option depends on the state of vision. In the case of a significant or total loss of vision and increasing ocular pain, cyclodestructive procedures may be considered [3]. However, too much damage to the ciliary body is associated with the risk of postoperative hypotonia and subsequent phthisis. Thus, performing such procedures in eyes with preserved vision should not be accepted. Partial destruction of the ciliary body, even in combination with local medication to reduce the intraocular pressure is not always effective. What remains is the formation of an artificial drainage pathway, with the Ahmed valve surgery as one of the most effective methods.

This method, applicable in both children and adults, is fairly well known. Depending on which model is used, the tube carrying the fluid to the valve mechanism is introduced into the anterior chamber (S and FP models) or to the vitreous chamber (PC and PS models). The latter models are designed with an additional pars plana clip changing the direction of the tube.

The use of each particular model has its benefits as well as limitations.

A too shallow anterior chamber prevents the use of anterior-chamber valves, whereas the PC and PS models can only be implanted following a pars plana vitrectomy.

Complications after the implantation of the anterior-chamber S and FP models include decompensation and corneal edema, progression of the cataract and erosion of the bulbar conjunctiva due to the presence of the tube [4-9]. Endophthalmitis is very rarely observed. One of the most common complications associated with using PC and PS models is the erosion
of the conjunctiva by the adapter which redirects the fluid drainage tube to the vitreous chamber [10]. It is also one of the most frequently listed causes of endophthalmitis. Erosion of the conjunctiva by the adapter was also observed in the early practice and occurred virtually

every time when this part was not covered with either with freeze-dried tissue (cornea, sclera) or Tenon's capsule. The conjunctival puncture also occurred in spite of covering the adapter with the tissues mentioned above [11,12].

MATERIALS AND METHODS

Eight persons (eyes) diagnosed with refractory glaucoma were subjected to a treatment to reduce intraocular pressure using an Ahmed valve, where in all cases the draining tube was introduced to the vitreous chamber, in an own (Cywiński's) modification.

In 5 cases the anterior-chamber S2 model was originally used. In the remaining 3 cases, a PS model valve was used, intended for the vitreous chamber (VC). In these patients, the adapter, i.e. the clip changing the direction of the tube, was removed. The reason was the erosion of the bulbar conjunctiva of the eye and partial eversion of the adapter followed by eye irritation, even though it was covered with a small flap of the freeze-dried sclera. The tube was reintroduced to the chamber according to own modification. All patients were pseudophakic, and 7 had previously undergone pars plana vitrectomy. In one case, a combined surgery was performed, where vitrectomy was carried out for the purpose of introducing a valve tube to the vitreous chamber. Too shallow anterior chamber, total obliteration of the filtration angle (status post congenital glaucoma surgery) were contraindications for the implantation of an anterior-chamber valve in that eye.

Before the Ahmed valve implantation, each patient not only underwent topical and general medication (Dorzolamid) but frequently also several surgical procedures, including trabeculectomy, cyclodestructive procedures (transscleral cyclophotocoagulation, TSCPC, or endoscopic cyclophotocoagulation, ECP), although without a long-term decrease in pressure.

The retrospective comparative analysis in the pre-operative and post-operative periods involved the readings of intraocular pressure, eyeball surface topography, and visual acuity.

Stages of the Procedure

1. Application of an S2 model valve.

- Pupil dilation
- Peribulbar anesthesia
- Dissection of the conjunctiva from the sclera in the superior temporal quadrant
- Formation of a 4-5 mm long intrascleral tunnel, 4 mm from the corneal limbus (a).
- Creation of an entry to the vitreous chamber at an angle of 45° at the end of the intrascleral tunnel (b).
- Fixation of the main part of the valve using non-dissolvable 6.0 stitches, 10-11 mm from the corneal limbus, after checking the patency of the valve (c)
- Shortening of the valve tube to the appropriate length, so that it touches the posterior surface of the lens without reaching its center
- Cutting the end of the tube at an angle of 45° to avoid contact between the cut part and the posterior surface of the lens (d)
- Irrigation of the vitreous chamber using the previously created access to the chamber and an additional irrigation port access (optional, when the intraocular pressure persists for longer than a few weeks after pars plana vitrectomy, and, as a consequence of this the vitreous fluid is very sticky).
- Passing the valve tube through the scleral tunnel, introducing it into the vitreous chamber at such an angle that it does not bend and thus becomes obstructed, and supporting the tube on the posterior surface of the lens (e).
- Suturing of the conjunctival wound.

Some stages of above application are showed on Fig.1.

2. Application of the PS model valve. Due to the prior introduction of the valve, earlier stages of the procedure were identical as in the case of the S2 model, barring the need to fix the main valve component. The additional stage involved the removal of the valve adapter changing the course of the tube and the scleral flap covering it.

RESULTS

During the 6 months of follow-up period, no further erosions of the conjunctiva by valve components were observed. The main Ahmed valve component was naturally covered by Tenon's capsule while the drainage tube of the valve was practically isolated from the conjunctiva due to the employed surgical technique. Visual acuity has improved in 3 patients (eyes) and slightly deteriorated in one patient (eye).

Post-Surgery Complications

Transient hemorrhage to the vitreous chamber was found in one patient. In another patient, the high intraocular pressure did not decrease after surgery. The reason was the obstruction of the tube by the thick fluid present in the vitreous chamber caused by the fluid not being exchanged due to the lack of drainage through the filtration angle. It was only after the irrigation of both the vitreous chamber and the valve that the IOP normalized. Raised IOP values reaching 24 mmHg were observed in 3 patients. Massaging the eyeball led to its immediate normalization, and the presence of a growing conjunctival bubble in the vicinity of the valve attested to its patency.

DISCUSSION

What were the main reasons to introduce the modification? Primarily to avoid the risk of late complications in future patients, including the erosion of the conjunctiva by the valve adapter in spite of being covered with freeze-dried tissue. Another reason was the erosion of the conjunctiva by this part of the valve already implanted in the eye while retaining its patency. The economic aspect, i.e. the option to introduce a cheaper, anterior-chamber Ahmed valve to the vitreous chamber, should also be considered. Obviously, the status post pars plana vitrectomy is the necessary qualifying factor. Taking own experience into account, performing a combined surgery, i.e. pars plana vitrectomy with the implantation of the Ahmed valve to the vitreous chamber enabled the normalization of interocular pressure in a 20-year-old patient diagnosed with refractory glaucoma, which occurred after congenital cataract surgery and, who could not be implanted with valve tube in the anterior chamber for technical reasons. An important component of this modification is the placement of the drainage tube at such an angle that it does not bend and in such a location behind the lens that it is visible, which allows it to be irrigated in the case of any obstruction.

CONCLUSIONS

The own modification of the surgical technique in which the anterior-chamber Ahmed valve is introduced to the vitreous chamber and the tube from the valve model intended for the vitreous chamber is reintroduced there after the removal of the adapter, which punctured the bulbar conjunctiva, is an effective procedure, applicable in pseudophakic patients who had previously undergone pars plana vitrectomy. It enables intraocular pressure normalization and decreases the risk of post-operative complications associated with the introduction of the tube to the anterior chamber and the presence of the adapter, frequently puncturing the bulbar conjunctiva. Furthermore, it has the advantage of reducing expenses due to the ability to use the cheapest type of the valve and no need to purchase freeze-dried tissues used to cover parts of the valve.

In the case of eyes after pars plana vitrectomy, one should always remember to irrigate the vitreous chamber before introducing the Ahmed valve tube due to the fluid present inside, which may obstruct the tube and the whole valve. This state is observed when the intraocular pressure increases for several weeks and the fluid present in the vitreous chamber gets significantly thickened due to the filtration angle being blocked, which interferes with its exchange (author's note).

Table1. *Compiles the information regarding age, type of valve used, additional diseases, intraocular pressure, and visual acuity observed before and 4 months after surgery.*

Mean age (years)	Cause of pars plana vitrectomy / No. of eyes	Type of Ahmed glaucoma valve used	Mean values of intraocular pressure (mmHg) before / after surgery	Mean distance BCVA (LogMAR) before surgery / after surgery	Mean near BCVA (Snellen) Before surgery /after surgery	Anti-glaucoma procedures performed before valve implantation	Pars plana vitrectomy / Ahmed valve combination surgery
52	Ocular complications of diabetes (5)	S2 (3) PS (2)	44/19	0,5/0,5	1,0/1,0	Trabeculectomy with Mitomycin. ECP, TSCPC	
65	Penetrating eye injury (1)	PS	41/22	0.5/0.5	0,5/0,75	TSCPC,	
38	High myopia (1)	S2	38/17	0,3/0,3	0,5/0,5	Trabeculectomy with Mitomycin	
21	After congenital glaucoma surgery (1)	S2	43/21	HM / 5letters from 1 meter	No reading	TSCPC, trabeculectomy, cyclocryotherapy	1(1)

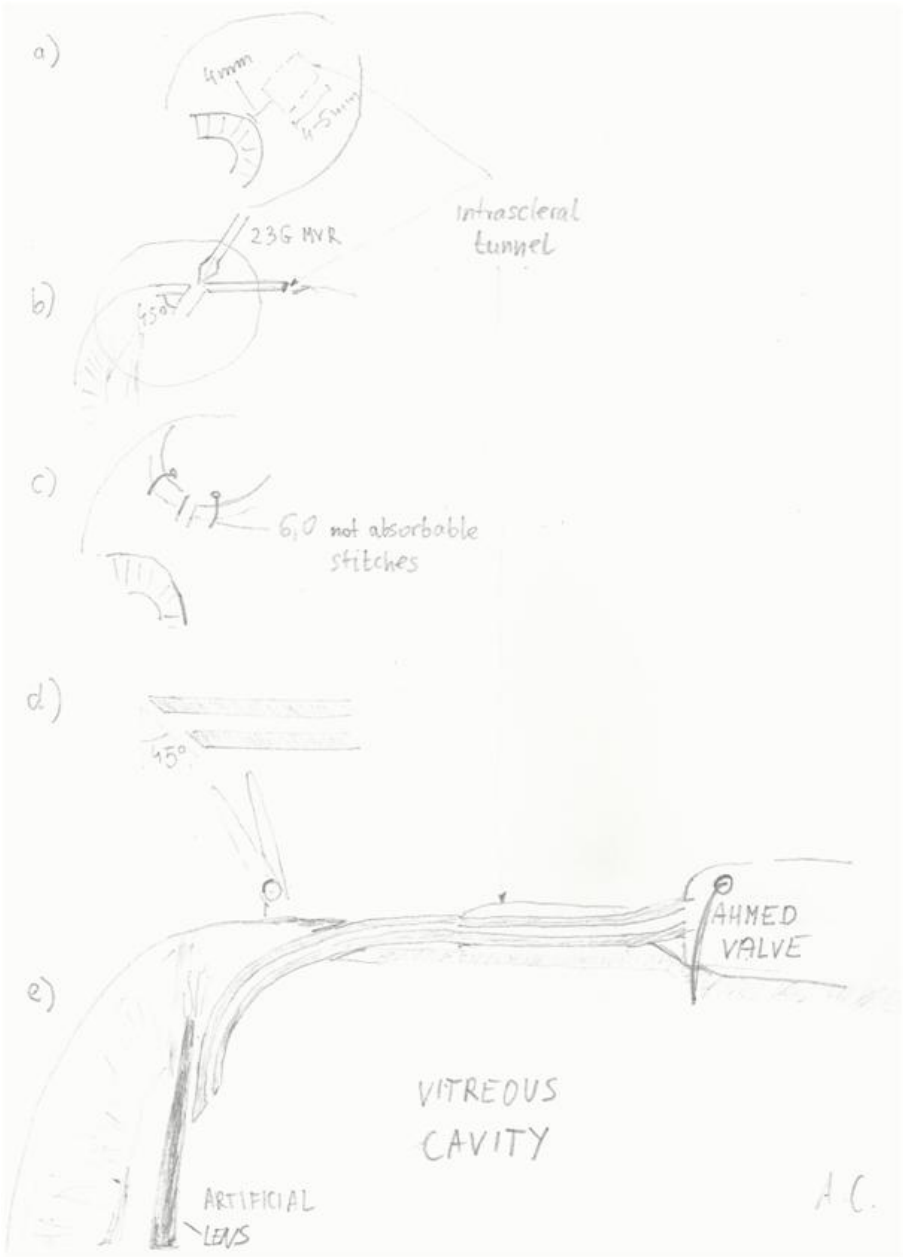

Figure1. *Shows some stages of Ahmed valve implantation using an own modification.*

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Citation: *Adam Cywinski & Lukasz Bednarski, "A Treatment of Refractory Glaucoma in Pseudophakic Patients after Posterior Vitrectomy using the Ahmed Valve in an Own Modification", International Journal of Research Studies in Medical and Health Sciences. 2019; 4(6): 01-05.*