

TREATMENT OF UVEITIC GLAUCOMA AND THE USE OF AHMED VALVE

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CLINICAL CASE

Patient: A 9-year-old Hispanic female.

Cause for referral 3/2000: management of uncontrolled glaucoma

Chief complain: pain, redness (OU), decreased visual acuity OD>OS and severe headaches

Past ocular history: a five-year history of bilateral panuveitis. She was treated with topical steroids only, without improvement of the ocular inflammation. Two years earlier, she underwent trabeculectomy with antimetabolite in both eyes. A year prior to her presentation to us, she underwent ECCE without lens implantation in the right eye and ECCE without lens implantation and cyclophotocoagulation in her left eye.

Initial Examination

Visual acuity: OD=20/200, OS=20/40

Slit-lamp: bilateral band keratopathy, iridectomy, trace cells in AC and aphakia. Conjunctival blebs present at 12 o'clock.

IOP: 32mmHg OD, 30mmHg OS

With topical Rescula bid, Cosopt bid, Alphagan qd and Prednefrin bid OU.

Ophthalmoscopy: Impressive, active chorioretinitis with no vitreous inflammation or vasculitis. Large retinal scars were present in the macula of both eyes OD>OS. The optic disc in both eyes was pale and atrophic. The cup/disc ratio was 0.9 OD and 0.8 OS (*Figure 1*)



Figure 1

Assessment:

- Bilateral uncontrolled glaucoma
- Bilateral progressive multifocal chorioretinitis

Plan:

- Bilateral Ahmed valve implantation to control elevated IOP
- Methotrexate subcutaneous injections in the initial dose of 5mg weekly, to control intraocular inflammation

Two weeks after initiation of MTX, the Ahmed valve drainage device was implanted in the right eye. Two months later, the same procedure was done on the left eye.

Postoperative course:

The patient was followed up closely in our Service during the first postoperative year. The left eye had a fairly smooth recovery. Immediately after surgery the intraocular pressure fell below 10 mm of mercury and remained so for almost 6 weeks. From 6 to 10 weeks, IOP rose steadily to reach 20 mmHg, around the third postoperative month. It then remained stable during the following two months. At that point, we had to administer a topical antiglaucomatous agent to lower the intraocular pressure. From 6 to 12 months after surgery the IOP followed a rocky course, but was retained below the level of 15mmHg, which represents a 50% reduction of the initial IOP.

The right eye had a more complicated course. The early reduction in IOP was rapidly reversed, due to the presence of hyphema. The first antiglaucomatous agent was administered as soon as 2 weeks after the surgery, but as the hyphema was slowly absorbing and IOP remained high, a second agent was added by the end of the second month. From 2 to 7 months the IOP was kept in the low twenties with the use of two medications. An unexpected rise in IOP at 7 months was attributed to a recurrence of uveitis in that eye. A combination of antiglaucomatous medications and topical steroids achieved to lower IOP close to the 15mmHg level.

During this first postoperative year the patient was under MTX therapy, the dose of which increased, accordingly to the degree of inflammation, from 5mg to 25 mg weekly. At the end of the first year she returned to her home country, where she still remains under regular follow-up.

Last follow-up examination



Figure 2:
Slit lamp
exa

mination at 2 years postoperatively.

Her most recent follow up examination at our Service, at approximately two years postoperatively, reveals the following:

Visual acuity: OD=20/80, OS=20/25

Slit-lamp: no signs of active inflammation

IOP: 09mmHg OU with topical Cosopt bid and Predforte bid, OU.

Ophthalmoscopy: No signs of active inflammation. She is still under MTX at 20mg weekly, a dose that she tolerates well.

UVEITIC GLAUCOMA

Epidemiology

Glaucoma is a common complication of uveitis. Its prevalence is 5- 19% in adults with uveitis. In children with uveitis glaucoma prevalence is similar ranging from 5-13.5% (40% of children with JRA uveitis). All forms of uveitis (anterior, intermediate, posterior, as well as panuveitis) can be complicated with secondary glaucoma.

Pathogenesis

Multiple mechanisms may lead to glaucoma in the uveitic patient.

Secondary open angle glaucoma can be caused by obstruction of the trabecular meshwork from inflammatory products, or trabeculitis. Other mechanisms include steroid-induced glaucoma, as well as secretion of inflammatory mediators such as prostaglandins that cause breakdown of the blood-aqueous barrier which in turn results to elevated aqueous protein content that can compromise outflow.

Secondary angle closure glaucoma can be caused by mechanical obstruction of the angle by extensive peripheral anterior synechiae formation, pupillary block, neovascularization of the angle or swelling of the ciliary body due to inflammation.

In many cases, however uveitic glaucoma may be the result of a combination of mechanisms.

Treatment

The management of uveitic glaucoma can be very challenging.

A. Medical treatment is very important. In some cases, treatment of the uveitis alone with corticosteroids or immunosuppressives can normalize the IOP. Mydriatics and cycloplegics are used to prevent and break posterior synechiae and to relax ciliary muscle and sphincter spasm.

Antriglaucomatous medications are reserved for those cases in which control of inflammation is not sufficient to lower IOP. Most classes of antiglaucomatous medications can be used. Aqueous suppressants are the most effective. Miotics should be avoided as they disrupt the blood aqueous barrier and enhance formation of posterior synechiae. Although our experience with prostaglandin analogs is still limited, there have been reports, that associate their use with adverse effects, such as increased IOP and recurrence of inflammation.

Unlike other types of glaucomas, those secondary to uveitis, respond poorly to medical therapy. This is especially true for children in which usually only carbonic anhydrase inhibitors are effective.

B. Surgical treatment in uveitic glaucoma is indicated in cases of uncontrolled IOP associated with progressive glaucomatous optic neuropathy despite maximally tolerated antiglaucomatous medical therapy. It is also indicated in cases of pupillary block angle-closure glaucoma.

The aim of glaucoma surgery is to correct anatomical abnormalities and provide a pathway for aqueous egress. Most types of glaucoma surgical procedures are applicable in uveitic glaucoma. In the section that follows, we present the short and long-term success rates of the different procedures that have been used for treatment of uveitic glaucoma.

1. Laser iridotomy or surgical iridectomy?

Both procedures are indicated in eyes with pupillary block. In general, laser procedures in uveitic eyes are difficult to perform and also have a high early failure rate, due to the associated inflammation (1). This is especially true for pigmented eyes. In our service, laser iridotomy is still offered to patients with blue irides while surgical iridotomy is preferred for those with brown irides.

2. Argon Laser Trabeculoplasty

As it is the case with laser, iridotomy, ALT is generally not effective in patients with uveitis (2).

3. Trabeculectomy has a fairly high early success rate, but in the long term this falls considerably, especially in younger patients, due to irreversible fibrosis and inflammation (Table 1). Wound healing modulators can be used to minimize scarring of the filtration bleb. The adjunctive use of antimetabolites, has been shown to enhance greatly the long term success rate of the procedure (Table 2)

Table 1: Short and long-term success rate of trabeculectomy for uveitic glaucoma

	1 year	2 years	5 years
Hoskins et al.	67 %		
Hill et al.	81%	73%	
Stavrou et al.	92%	83%	
Towler		80%	30%

Table 2: Short and long-term success rate of trabeculectomy with antimetabolite, for uveitic glaucoma

	1 year	2 years	5 years
Prata et al.	75%		
Jampel et al.	100%		
Patitsas et al.			71%
Towler		90%	50%

Although antimetabolites are effective in controlling excessive scarring, their use is associated with potential complications, such as:

- Early: prolonged wound healing, epithelial defects, suture and conjunctival wound leaks, hypotony (choroidal hemorrhage and hypotony maculopathy).
- Late: late bleb rupture and bleb leaks. Bleb related postoperative endophthalmitis (5.7%)

4. Cyclophotocoagulation

Transcleral Nd:YAG cyclophotocoagulation has been proposed as an alternative to trabeculectomy in aphakic and pseudophakic eyes. At one-year the success rate is 72% (10) and falls to 52% at 3 years (11). Patients with secondary traumatic or uveitic glaucoma tend to be less responsive to CPC.

5. Trabeculodialysis

It is a modified goniotomy, which has been reported to be successful in 60-70% of children and young adults with uveitic glaucoma. (12)

6. SHUNTING DEVICES

In an effort to overcome the problem of filtration surgery failure due to fibrosis and scarring, and the complications of antimetabolite use, shunting devices have been looked upon as a promising treatment option in patients with uveitic as well as other forms of refractory glaucoma.

Shunting devices work by shunting aqueous from the AC (or vitreous cavity) through a tube to a distal reservoir. The body of the implant creates the surface area for aqueous diffusion. Filtration blebs that develop around a posteriorly placed implant are similar histologically to trabeculectomy blebs. Both have a double-layered capsule consisting of Tenon's capsule and the overlying conjunctiva. The aqueous must percolate through both layers with passive diffusion. However, the capsule forming around a glaucoma drainage device is found to be more reproducible and consistently organized, compared to the filtration bleb of trabeculectomy (13). Lymphatics & blood vessels overlying the implant pass then the escaping aqueous onto the systemic circulation.

Outcomes

Although the short-term success rate of shunting devices in uveitic glaucoma is comparable to that of filtering surgery with antimetabolites, the former meet with higher survival rates in the

long-term. Table 3 presents the results of a review of the literature on the efficacy of shunting devices in the treatment of uveitic glaucoma.

Table 3: Short and long-term success rates of shunting devices for uveitic glaucoma

	Type of shunt	1 year	1-2 years	2-5 years
Hill et al.	Molteno		79%	
Omi et al.	Schocket	100%		
Freedman et al	Molteno			80%
Airaksinen et al.	Molteno		83%	
Goldberg et al.	Molteno	71%		
Krishna et al.	Baerveldt		60%	
Mills et al.	Molteno			75%
Gil-Carrasco et al.	Ahmed		57%	
Da Mata et al.	Ahmed	94%		

Indications for shunting devices: Implantation of a glaucoma shunting device is indicated as a primary procedure in cases where trabeculectomy with adjunctive antimetabolite is thought to have a very low chance of success (Neovascular Glaucoma, aphakic or pseudophakic glaucoma as well as glaucoma after penetrating keratoplasty and pars plana vitrectomy, pediatric glaucoma and glaucoma associated with uveitis and ICE syndrome or advanced epithelial ingrowth).

Other indications for primary implantation of glaucoma shunting devices, include cases in which trabeculectomy with antimetabolite therapy has a high risk of postoperative complications, such as in cases with severe ocular surface disease

Finally, as a secondary procedure, glaucoma drainage devices are implanted usually after a failed trabeculectomy with antimetabolite therapy.

Types of shunting devices

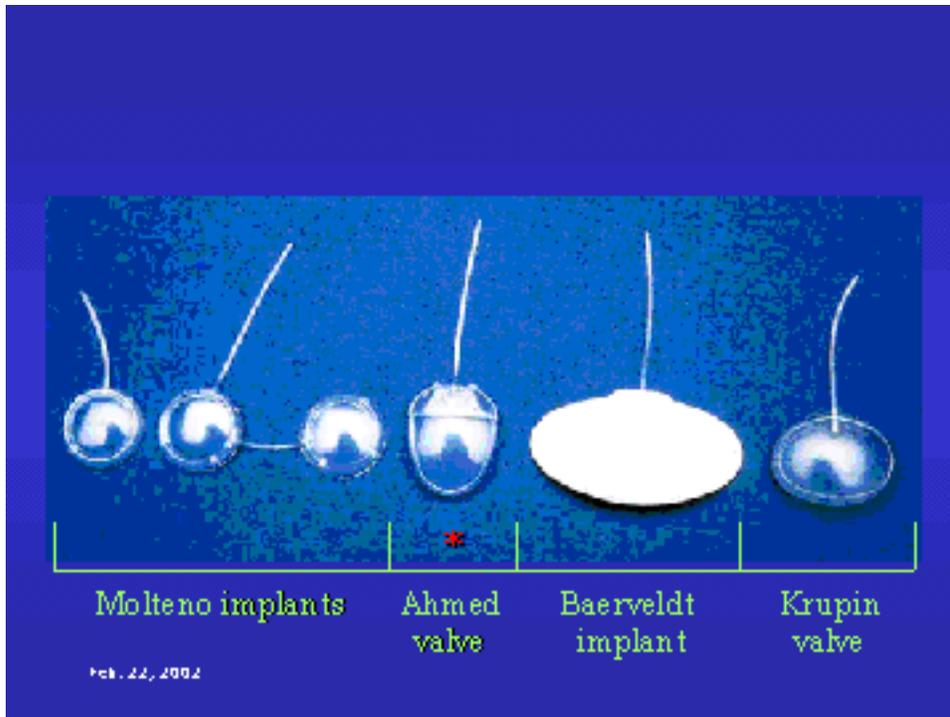


Figure 3: Different implant designs

Many different types of shunts are available (*Figure 3*). In general these can be divided into restrictive and non-restrictive types. The latter allow free outflow of the aqueous, regardless of the IOP level. The non-restrictive ones incorporate a valve mechanism, which provides some resistance to outflow, thereby decreasing the likelihood of hypotony.

The Ahmed Glaucoma Valve Implant consists of a silicone tube attached to an elliptical polypropylene body and plate. The valve mechanism consists of two silicone elastomer membranes, which create a Venturi-shaped chamber. The membranes are pretensioned to open and close in response to changes in IOP. The valve is designed to open when the IOP is 8 mmHg or greater.

Ahmed Valve implantation « Perioperative management

As it is the case with any type of surgery performed in an eye with uveitis, glaucoma shunt implantation should not be undertaken unless the uveitis is under excellent control.

In our service, the following protocol for perioperative management is applied. Immunosuppressive chemotherapy is intensified with the adjunctive use of prednisone at a dose of 1mg/kg/day 3 days before surgery. Prednisone is then tapered within four weeks. Topical steroids are also administered, as needed, according to the degree of anterior segment inflammation.

Ahmed Valve implantation « The procedure

Implantation of an Ahmed valve involves the following steps:

- Generally, a fornix-based conjunctival flap is created in the superotemporal quadrant of the eye.
- The sclera is marked at 9mm from the limbus, where the anterior border of the plate is going to be sutured.
- The tube is flushed with sterile BSS to confirm that the valve is functioning properly.

- The body of the valve is tucked into the sub-Tenon's space between the superior and lateral recti muscles.
- The plate is sutured to the sclera with its anterior border measured 9mm behind the limbus.
- The tube is then placed over the cornea, measured and cut, with bevel-up, at 2-3mm from the limbus.
- A 23-gauge needle is used to create a tract into the anterior chamber at the surgical limbus. In aphakic or vitrectomized eyes the opening is fashioned in the pars plana, for insertion of the tube into the vitreous cavity.
- The tube is then inserted through the tract into the anterior chamber or the vitreous cavity.
- The body of the exposed tube is sutured onto the sclera with non-absorbable sutures to avoid the risk of tube migration.
- The function of the valve is tested by injecting BSS into the anterior chamber through a paracentesis.
- A rectangular piece of processed pericardium is sutured over the exposed tube adjacent to the limbus.
- The conjunctival flap is pulled over the graft and sutured to the limbus. Care is taken to cover meticulously the area or the tube with intact conjunctiva as inadequate covering, and buttonholes in the conjunctiva, and wound leak can cause severe hypotony in the early postoperative term.

Postoperative course:

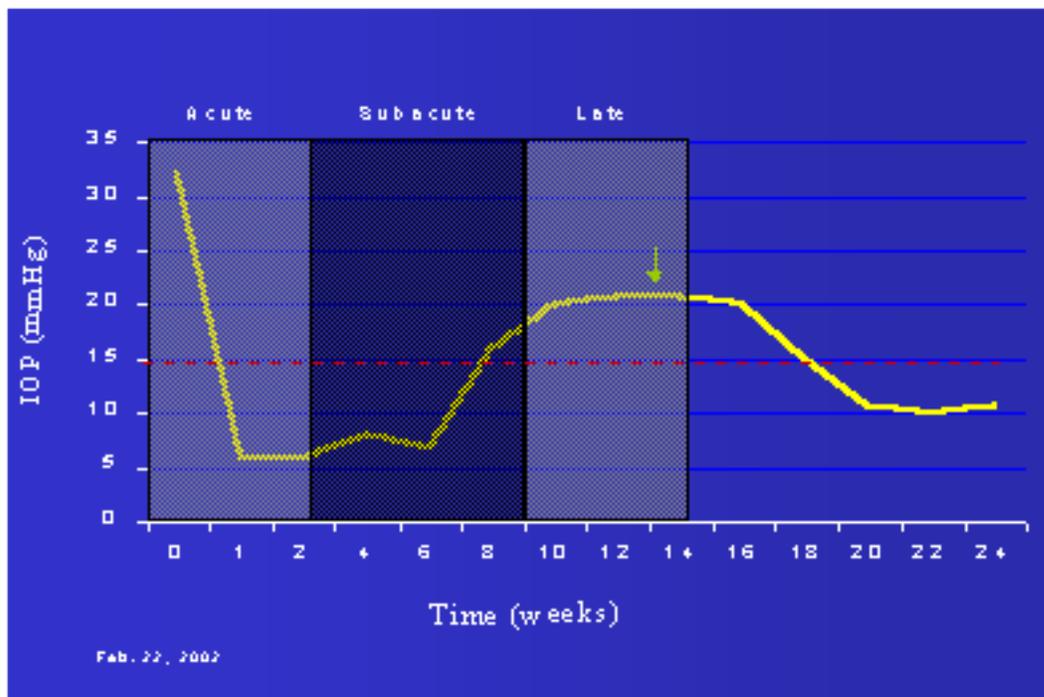


Figure 4: IOP fluctuations during recovery from a shunting procedure. This is the diagram depicting the postoperative course of the IOP in the left eye of our patient. The three distinct phases can be easily distinguished. The arrow indicates the point where we had to administer an antiglaucomatous medication to lower the IOP.

Three distinct phases in IOP have been described after implantation of a glaucoma drainage device (*Figure 4*)

The acute, hypotensive phase starts immediately after surgery and lasts up to 2-4 weeks. During

this period the IOP is dramatically decreased as aqueous flows freely to the subconjunctival space.

The subacute, hypertensive phase extends from 2 to 9 weeks. This is the period where a fibrous pseudocapsule is forming around the implant. The capsule restricts aqueous outflow, thereby inducing a steady increase in IOP.

The late normotensive phase: during the subsequent 4 to 6 weeks the capsule becomes vascularized and aqueous diffuses into the blood vessels. As vascularization of the bleb begins, a gradual decline in IOP will occur.

The size and thickness of a bleb formed over the implant body plays an important role in the rate of aqueous diffusion. Since the location of the bleb is too posterior to be visible on slit lamp examination, these parameters should best be followed by orbital ultrasound. (Figure 5)

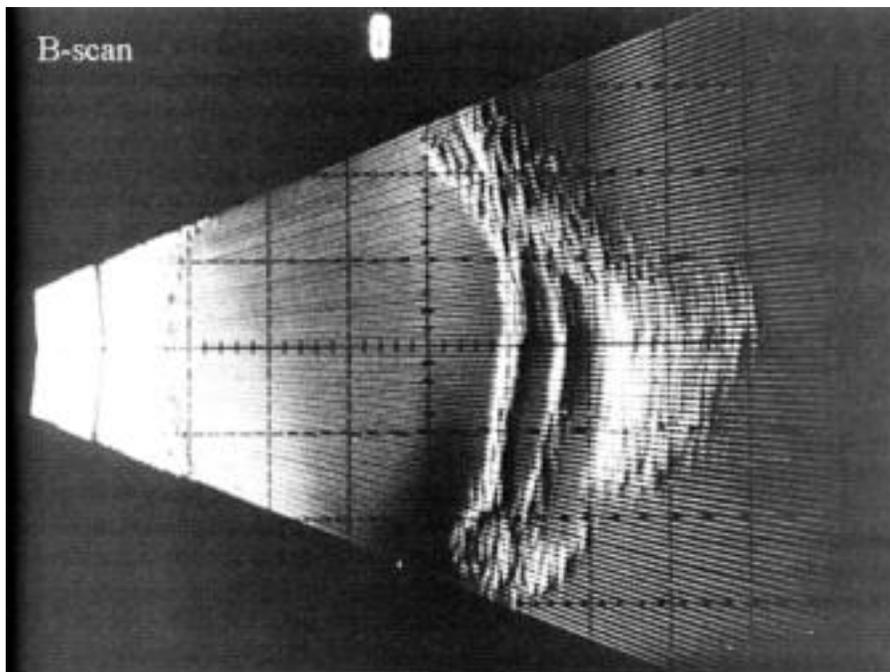


Figure 5: B-scan ultrasound of a functioning bleb around a shunting implant. The

middle echo represents the plate, which is surrounded by echo lucent fluid on both sides. Characteristic is the flattening of the adjacent eye wall.

Complications of Ahmed valve implantation

Hypotony is by far the most serious postoperative complication. Early postoperative hypotony due to overfiltration is expected after implantation of a glaucoma drainage device. This is reversed as the fibrous capsule starts to form. The use of valved implants minimizes the risk of hypotony. Although postoperative hypotony is possible with the Ahmed valve, this is not associated with an increased incidence of flat anterior chambers or serous choroidal detachments (22).

In cases of late-onset hypotony, reasons other than an overfiltrating valve should be suspected. Severe or prolonged hypotony should be treated to avoid the risk of secondary complications that can permanently affect vision. These include cataract, corneal decompensation and hypotony maculopathy. Treatment is according to the underlying etiology.

Elevation of IOP

Obstruction of the tube lumen may cause early elevation of IOP after a glaucoma shunt implantation. The obstruction might result from incarceration of iris, vitreous or posterior capsule remnants in the proximal ostium as well as obstruction of the lumen by a clot of fibrin or blood. Several techniques have been used to open an occluded tube such as intracameral TPA injection to dissolve a fibrin or blood clot, tube irrigation with sterile BSS through a paracentesis opening and Nd: YAG laser for posterior capsule remnants.

Late IOP elevation, especially when the intraocular portion of the tube appears patent, is usually due to excessive fibrosis of the capsule that surrounds the implant. In cases resistant to medical therapy, reoperation with removal of the capsule may be justified.

Corneal complications

After Ahmed valve implantation for various types of glaucoma, the frequency of corneal complications varies from 6-50%. In a large series of 60 eyes with Ahmed valve implantation followed up for 4 years, corneal decompensation or graft failure was the most common long-term complication (23). In some instances the cause for that is easily identified, such as in cases with tube-endothelial touch due to bad positioning of the tube or prolonged hypotony with flat anterior chambers.

There are cases however, when no causative factor can be identified. Several possible explanations have been proposed for the occurrence of corneal complications in such cases. These include the theory of transient tube-endothelial cell contact with blinking or rubbing of the eye, previous surgery or history of intraocular inflammation (23).

Conjunctival melting

This complication usually occurs near the limbus overlying the tube and may be related to poor graft preparation or placement. In some cases this complication can occur without the presence of these factors. Replacement of the graft and mobilization of a conjunctival sliding graft may be required to repair these defects.

Conclusions

The management of uveitic glaucoma can be complex and challenging. Multiple procedures are often required. Shunting devices seem to have a better long-term survival rate than filtering surgery with antimetabolites. Ahmed valve implantation is relatively safe and effective for controlling IOP in patients with uveitic glaucoma. Long-term control of inflammation increases the success rate of the procedure.

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TREATMENT OF UVEITIC GLAUCOMA AND THE USE OF AHMED VALVE

Review Questions

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1. Which of the following statements regarding uveitic glaucoma is (are) false?
 - A. Approximately 15% of patients with uveitis will develop glaucoma
 - B. The most common mechanism of uveitic glaucoma is that of secondary angle closure
 - C. Topical steroids should be avoided in patients with elevated IOP secondary to uveitis
 - D. All classes of antiglaucomatous medications may be used in cases of glaucoma secondary to uveitis

2. Which of the following procedures is not indicated for treatment of uveitic glaucoma?
 - A. Filtration surgery with antimetabolites

- B. Laser iridectomy
- C. Shunting devices
- D. Laser trabeculoplasty

3. Which of the following is not absolute indication(s) for surgery in uveitic glaucoma.

- A. Intraocular pressure >30mmHg
- B. Pupillary block angle-closure glaucoma
- C. Steroid responsiveness
- D. Progressive glaucomatous optic neuropathy despite maximum topical therapy

4. Filtration surgery for uveitic glaucoma:

- A. Is successful only in the short-term (<1 year)
- B. With the use of antimetabolites, its long-term success rate is greatly enhanced (from 30% to as much as 70%)
- C. The use of antimetabolites in filtration surgery increases dramatically the complication rate of the procedure
- D. All of the above

5. Implantation of shunting devices is advantageous over conventional filtration surgery because:

- A. Is a non-penetrating procedure and therefore is associated with less postoperative-induced inflammation
- B. Shunting devices can be used in aphakic or vitrectomized eyes, where filtration surgery is contraindicated
- C. The capsule that forms around a shunting device is more reproducible and consistently organized, compared the filtration bleb of trabeculectomy

D. A+B

E. B+C

F. A+C

6. Which of the following is the most important success determinant of shunting device implantation for uveitic glaucoma:

- A. The preoperative level of IOP
- B. The type of the implant
- C. The level of control of inflammation, perioperatively

D.All of the above

7. Apart from uveitic glaucoma, other indications for shunting device implantation include:

A. Failed filtration surgery with antimetabolite

B. B.Severe ocular surface disease

C.Neovascular glaucoma

D.Advanced epithelial ingrowth

E.All of the above

8. Which of the following glaucoma drainage implant types are considered ¿restrictive¿:

A. Molteno

B.Ahmed

C. Baerveldt

D.A+B

E.B+C

9. Which of the following statements is false, regarding recovery after implantation of an Ahmed Glaucoma Valve?

A. Immediately postoperatively, IOP is extremely low

B. By the end of the first postoperative month, IOP starts to increase, due to formation of a fibrous capsule around the implant

C. By the end of the second month, IOP declines gradually as vascularization of the capsule begins

D. IOP remains stable after the third postoperative month in uncomplicated cases of Ahmed valve implantation

10. Which of the following is the most common long-term complication of Ahmed Valve implantation

A. Early hypotony

B. Capsule fibrosis with elevation of IOP

C. Choroidal detachments

D. Corneal decompensation

E. Conjunctival melting

F. Tube occlusion

ANSWER KEY

1. B+C
2. D
3. A+C
4. D
5. E

6. C
7. E
8. B
9. D
10. D