PEDIATRIC GLAUCOMA : DEFINITION

All Glaucoma in pediatric age (less than 18 years).
- Congenital/infantile Glaucoma
- Dysgenetic Glaucoma
- Glaucoma after Cataract surgery
- Uveitic Glaucoma
- Juvenile Glaucoma
MANAGEMENT OF PEDIATRIC GLAUCOMA

Diagnosis and therapeutic emergency: in Congénital Glaucoma
And relatively Less emergency : in Children

Surgical treatement is often necessary

SURGICAL MANAGEMENT OF PEDIATRIC GLAUCOMA

-Goniotomy
-Trabeculectomy
-Combined Trabeculectomy-Trabeculotomy

Have high success rates when performed as initial surgical procedure

But with these technics the results are poor in case of secondary refractory infantile glaucoma: like in some dysgenesis glaucoma:Sturge weber syndrom,Aniridia and after congenital cataract surgery

The use of Mitomycin C is very risky because of a lower scleral rigidity
IN THE MANAGEMENT OF PEDIATRIC GLAUCOMA THERE IS A HISTORY OF MULTIPLE SURGERY

- Many surgery : for the same eye
- All diagnosis
  Fibrosis +++
  Refractory G : in young patients++

ALTERNATIVES

- techniques to produce weak ciliarybody
- Glaucoma Drainage Device (GDD)
DRAINAGE SYSTEMS

-TUBE

-VALVE reservoir: regulation system of aqueous humor against hypotony

DRAINAGE PROTHESIS

TUBES: - Schocket
- Molteno

VALVES: - Krupin
- Mendez
- Baerveldt
- Ahmed. +++
AHMED VALVE DEVICE

-Invented by Mateen AHMED

In California

-F.D.A. agreement in 1993. Ahmed valve:
- silicon tube: 25 mm.
- valve: elastomer membrane folded in 2 with a concave polypropylene shell

AHMED VALVE: PRESENTATION

16 mm, 13 mm, thickness: 1,9 mm 10mm-9,6 mm

• Silicon tube
• polypropylene valve

B1: biplate: 364 mm2

S2: 184 mm2

S3: 96 mm2
AHMED VALVE: NEW PRESENTATION  THE FLEXIBLES

FP7: 184 mm²
FP8: 96 mm²
FX1: 364 mm²

AHMED VALVE: PRINCIPLE

Pump type: with a Venturi flow
Elastomer Membrane folded in two.
Works like BERNOUILLI’s principle.
IN VITRO STUDY

EISENBERG, F MAY : in expertise

Study of different drainage prothesis :

- Only the Ahmed GV works really like a valve :
  ➢ Opening Pression of 13,6 mm and
  ➢ Closing Pression of 6,1 mm.

- The Baerveldt Implant and Optimed regulator works like a simple duct.

MATERIALS AND METHODS

Retrospective study

- 123 Pediatric Glaucoma, 158 eyes
- Mean follow up: 82,3 months ± 14,8
- April 1995 - December 2018
- Model of Ahmed valve G: S3, S2, FP7, FP8

The aim of the study: to discover the outcomes of AVG: efficacy, and safety

The purpose of the study was to assess the IOP control, changes in visual acuity, complications and risk factors of failure following the implantation of Ahmed glaucoma Valve (AGV) in eyes with pediatric glaucoma
BREAKDOWN OF PEDIATRIC GLAUCOMA

- Primary congenital/infantile G: 53 eyes
- ICE syndrome: 12 eyes
- Rieger syndrome: 14 eyes
- Aniridia: 8 eyes
- Peters syndrome: 12 eyes
- Aphakic G: 13 eyes
- Pseudophakic G: 16 eyes
- Uveitic G: 9 eyes
- Juvenile G: 15 eyes

TECHNICAL SURGERY

- ANAESTHESIA, General anesthesia ++
- VALVE IMPLANTATION: FP7, FP8:
  ➢ Temporal upper: 148 eyes
  ➢ Nasal: 10 eyes
    - Conjunctival flap 7-10 mm to limbus
    - Between rectus muscles: upper/ lateral
    - Scleral fixation.
    - Tube in Anterior chamber through scleral flap
      (or patch).
SUCCESS CRITERIONS OF GDD

IOP between 6 and 21 mm Hg at 2 successive visits without:

- other surgery or
- Decrease of Visual Acuity not more than 2 lines at Snellen scale neither loss of Light Perception
- Absence of important complication:
  - Chronical hypotony
  - Malignant Glaucoma, endophtalmitis; phthysis or corneal decompensation
PRE AND PEROPERATIVE EXAMINATION

- Sexe, age, type of glaucoma
- Visual acuity when it's possible
- IOP measurement
- Gonioscopy, fundus evaluation
- Previous surgery performed
- The model of AGV used and the quadrant of surgery
- The location of placement of the tube
- Intraoperative surgery complications

RESULTS

- AGE: 1-16 years
  (mean = 11.3 ± 4.8 years)
- Number of previous surgery: 2-6; second intention surgery in all cases
- Number AGM: 3.58 ± 1.2
- Preoperative IOP with treatment: 28-41 mm Hg
  (mean = 34.9 ± 6.2 mm Hg)
- Postoperative IOP: 6-18 mm Hg (mean = 10.2 ± 4.5 mm Hg)
- Follow-up: 1-23 years
FUNCTIONAL RESULTS

102 Eyes: VA: stable
56 Eyes: VA: decrease
- 11 Eyes with an obturant cataract
- 17 Eyes: explanted
- 10 Eye (CG): had loss LP
- 1 case of endophtalmitis: streptococcus

AVERAGE OF NUMBER OF GLAUCOMA MEDICATIONS

Very important increase of AGM number after the 5th year
KAPLAN MEIER SUCCESS RATE WITH AHMED VALVE IN PEDIATRIC REFRACTORY GLAUCOMA IN OUR STUDY

Success rate:
- 1 year: 90.59%
- 2 years: 87.8%
- 3 years: 83.8%
- 4 years: 63.3%
- 5 years: 53.3%
- 6 years: 54.2%
- 10 years: 34%
- 23 years: 23%

EVALUATION OF HYPERTONIC PHASE AFTER VALVE D’AHMED

CAPRIOLI
- Hypertonic phase after 5 weeks mean (3 at 6 weeks)
- Give a complementary treatment

In our study: 35% had an hypertonic phase which was monitored with AGM
COMPLICATIONS: EYES (54%)

- Hypotony: 21.6%
- Tube obstruction: 10.8%
- Fibrosis: 10.8%
- Choroidal detachment: 5.4%
- Tube extrusion: 5.4%
- Tube migration: 2.7%
- Corneal decompensation: 2.7%
- Hypheama: 1.2%
- Cataract: 1.2%
- Endophtalmitis: 1 case

COMPLICATIONS

TUBE EXTRUSION

TENON CYST
TUBE RETRACTION

Treated with Tube extender

DISCOVERED VALVE

Discovered valve Tube migration
AHMED VALVE AND ET KP

Transitory corneal oedema
2 Cases after KP

COLEMAN: KP the success rate 20 - 30%

POST-OPERATIVE DIPLOPIA

One case of pseudo-Brown syndrom in upper nasal position
Near the optic nerve +++
ENDOPHTALMITIS

- 1 Case endophtalmitis after discovered VA: streptococcus
- Any case of malignant glaucoma, or bulbar phthisis

OTHER COMPLICATIONS IN LITERATURE

- Decompression retinopathy
- Retinal detachment
- Iris blocking tube
- **Endophtalmitis**: 1,7 % streptococcus et haemophilus influenzae, children +++
AHMED VALVE COMPLICATIONS:
LITTERATURE STUDY (60 - 448 EYES).

choroidal effusion: 22-30%
Athalamy: 12-23%
Hyphoema: 15-19%
tube misposition: 7-10%

Hyponony: 3-6%
Strabismus: 4-5%
Expulsive: 5-6%
Pupillar membrane: 3-8%

HYPOTONY

Less frequent with Ahmed GDD: 8 - 13% Against:
-32%: Baerveldt valve
-24%: Krupin valve
-20%: Molteno tube
AHMED VALVE: REMEMBER THE CONJUNCTIVA REACTION

Safety but don't forget that there is a conjunctival effraction and the classic problem of fibrosis +++

AHMED VALVE AND MITOMYCINE C

COSTA (Brasil) showed in a:

Double blind study that Mitomycin C didn't increase the success rate of Ahmed valve GDD
### SUCCESS RATE: COMPARATIVE RESULTS

<table>
<thead>
<tr>
<th>Follow up</th>
<th>1 year</th>
<th>2 years</th>
<th>4 years</th>
<th>6 years</th>
<th>10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayyala</td>
<td>77 %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Topouzis</td>
<td>87 %</td>
<td>82 %</td>
<td>76 %</td>
<td>76 %</td>
<td></td>
</tr>
<tr>
<td>Coleman</td>
<td>78 %</td>
<td>68 %</td>
<td>65 %</td>
<td>60 %</td>
<td></td>
</tr>
<tr>
<td>our study</td>
<td>75 %</td>
<td>73 %</td>
<td>67 %</td>
<td><strong>54 %</strong></td>
<td><strong>34 %</strong></td>
</tr>
</tbody>
</table>

### RECENT PUBLICATIONS ABOUT THIS SURGERY

**CONCLUSION:**
Although the short-term success rate of AGV revision in children is high, with longer follow-up the success rate decreases significantly. (Am J Ophthalmol 2017;183:141–146. 2017 Elsevier Inc. All rights reserved.)
EPIDEMIOLOGY AND SUCCESS RATE

Patients characteristics

The success rates for all eyes were 85.7% (95% CI, 79.7%-92.2%) at 1 year and 36.8% (95% CI, 26.8%-50.4%) at 10 years

Patients characteristics table:

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uveitic glaucoma</td>
<td>36</td>
<td>36.3%</td>
</tr>
<tr>
<td>Secondary</td>
<td>61</td>
<td>61.2%</td>
</tr>
<tr>
<td>Implant type</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Silicone</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>64</td>
<td>64.1%</td>
</tr>
<tr>
<td>Congenital</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Age at intervention</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Age of diagnosis</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Primary glaucoma</td>
<td>35</td>
<td>35.3%</td>
</tr>
<tr>
<td>Therapeutic glaucoma</td>
<td>12</td>
<td>12.1%</td>
</tr>
<tr>
<td>Hypertensive</td>
<td>15</td>
<td>15.0%</td>
</tr>
<tr>
<td>Nonglaucoma</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
The use of Ahmed glaucoma valve in the management of pediatric glaucoma

Shantha Balekuduru, DNB, Juhie Vadalkar, MS, Ronnie George, MS, and Lingam Vijaya, MS

**PURPOSE**

To assess the intraocular pressure control (IOP), changes in visual acuity, complications, reoperation rates and risk factors for failure following Ahmed glaucoma valve implantation in pediatric eyes with glaucoma.

**METHODS**

The medical records of consecutive patients with glaucoma who underwent Ahmed glaucoma valve implantation from January 2000 to December 2009 were retrospectively reviewed. Only one eye of each patient was included. Subgroup analysis was performed in three groups; group 1 included phakic eyes with primary congenital glaucoma, juvenile open-angle glaucoma, or glaucoma associated with ocular anomalies; group 2 included eyes with glaucoma in aphakia or pseudophakia; group 3 included eyes with other diagnoses. A successful outcome was defined as final IOP between 6 mm Hg and 18 mm Hg without loss of light perception or reoperation for glaucoma.

**RESULTS**

A total of 71 eyes in 71 patients: 15 (21%) in group 1, 47 (66%) in group 2, and 9 (13%) in group 3 were included. Successful IOP control was achieved in 44 eyes of 44 patients (62%). Cumulative probabilities of success by Kaplan-Meier analysis at 12 and 24 months was 97% and 80% for the entire group, 100% and 82% for group 1, 95% and 86% for group 2, and 90% and 42% for group 3. Reoperation was necessary for 18 patients (25%), either for tube-related complications or for IOP control. The only significant risk factor for failure was the category of diagnosis ($P = 0.029$).

**CONCLUSIONS**

Ahmed glaucoma valve implantation is an option in the management of pediatric glaucoma; however, reoperations for tube related complications or for persistent elevated IOP is frequently needed. (J AAPOS 2014;18:351-356)

**Table 1. Baseline demographics of patients**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean</th>
<th>± Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, months</td>
<td>82.07</td>
<td>± 58.31</td>
</tr>
<tr>
<td>Median</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>2-204</td>
<td></td>
</tr>
<tr>
<td>Male:female</td>
<td>40:31</td>
<td></td>
</tr>
<tr>
<td>OD:OS</td>
<td>36:35</td>
<td></td>
</tr>
<tr>
<td>Follow-up, months</td>
<td>37.79</td>
<td>± 32.11</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>3-126</td>
<td></td>
</tr>
<tr>
<td>Glaucoma diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary congenital/developmental glaucoma/JOAG/glaucoma associated with ocular anomalies (phakic eyes)</td>
<td>15 (21.1%)</td>
<td></td>
</tr>
<tr>
<td>Glaucoma in aphakia and pseudophakia</td>
<td>47 (66.1%)</td>
<td></td>
</tr>
<tr>
<td>Post-traumatic glaucoma</td>
<td>2 (2.8%)</td>
<td></td>
</tr>
<tr>
<td>Uveitic</td>
<td>3 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>Secondary angle closure glaucoma</td>
<td>1 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Silicon oil induced glaucoma</td>
<td>3 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>Prior surgeries, median (range)</td>
<td>2 (0-5)</td>
<td></td>
</tr>
<tr>
<td>Associated congenital anomalies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anirida</td>
<td>4 (5.6%)</td>
<td></td>
</tr>
<tr>
<td>Peters anomaly</td>
<td>4 (5.6%)</td>
<td></td>
</tr>
<tr>
<td>Turner syndrome</td>
<td>1 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Microcornea and microphthalmos</td>
<td>3 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>Choroidal coloboma</td>
<td>1 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Phacomatosis pigmenta vascularis</td>
<td>1 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Congenital hereditary endothelial dystrophy</td>
<td>2 (2.8%)</td>
<td></td>
</tr>
<tr>
<td>Rubella</td>
<td>2 (2.8%)</td>
<td></td>
</tr>
<tr>
<td>Microphthalmia</td>
<td>1 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Corneal graft status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failed graft prior to surgery</td>
<td>8 (54%)</td>
<td></td>
</tr>
<tr>
<td>Clear grafts</td>
<td>7 (46%)</td>
<td></td>
</tr>
</tbody>
</table>
DISCUSSION

- Ocular hypertensive phase occurred in 23 eyes (32%); mean IOP 29.3 mmHg.

Success rate: 54%-95% have been reported. This variation in surgical results reflects the difference between the definition of success or failure and the population of patients.

The upper limit of IOP was not well defined.

Also by the WGA World Glaucoma Association: 21-18 or 12 mm Hg.

- USE in this series: of antifibrotic agents like Mitomycin C or Bevacizumab.
CONCLUSION: ADVANTAGES OF AHMED G VALVE

- Interesting alternative in refractory pediatric glaucoma
- Technically simple: in one operatory time but
  - Rares complications
- Success rate at 10 years: 34.5% and only 23% at 23 years
- New tendency: first intention in pediatric glaucoma: Coleman, Essayed
  - Limits: Conjunctival effraction with a high rate of conjunctival complications

In our group, it is a second intention surgery and the conjunctiva was not well and often agressed in the past.

don't forget also that the sclera is thin in pediatric glaucoma population
- Last: Expensive cost in our countries.

But in refractory pediatric glaucoma, Ahmed Glaucoma Device remain a good option when we cannot do anything else.