RECENT ADVANCES OF GLAUCOMA DRAINAGE IMPLANTS

Essay
Submitted for partial fulfillment of
Master Degree in Ophthalmology

By

Islam Hosni Abul Maati

M.B., B.Ch.

Under Supervision of

Prof. Dr. Fatma Mohamed El Hennawi
Professor of Ophthalmology
Faculty of Medicine
Ain Shams University

Dr. Dina Ezzat Abd El Aziz
Lecturer of Ophthalmology
Faculty of Medicine
Ain Shams University

Faculty of Medicine
Ain Shams University
Cairo 2006

Introduction

Glaucoma drainage devices are an option in the management of complicated glaucomas that carry high risk of failure from conventional filtering surgery. Because cyclodestructive procedures carries high risk of atrophia bulbi, many glaucoma surgeons believe that glaucoma drainage devices are good alternatives to cyclodestructive procedures specially in eyes that are visually potential. ***(Lloyd et al. 1996 & Hodkin et al. 1999)***

The most common drainage device in use today is based on a design introduced by Molteno in 1969. The major disadvantage of Molteno implant is early postoperative hypotony with its associated complications such as flat anterior chamber, serous and hemorrhagic choroidal detachments. Modifications in the various implant designs have been developed in attempt to limit the occurrence of postsurgical hypotony. (***El Syyad et al., 1998)***

Currently drainage devices can be divided into two groups, those with valves and those without valves. The non-valved are the various types for ex, Molteno implants, the Baerveldt implant, and the Schocket encircling tube. Valved implants for ex, the Krupin disc and the Ahmed Glaucoma Valve. (***Coleman et al., 1999)***

AIM OF THE WORK

The aim of this study is to discuss different mechanisms of glaucoma implants and their uses for treatment of pediatric and refractory glaucoma.

Introduction

Glaucoma drainage devices are an option in the management of complicated glaucomas that carry high risk of failure from conventional filtering surgery. Because cyclodestructive procedures carries high risk of atrophia bulbi, many glaucoma surgeons believe that glaucoma drainage devices are good alternatives to cyclodestructive procedures specially in eyes that are visually potential. ***(Lloyd et al. 1996 & Hodkin et al. 1999)***

The most common drainage device in use today is based on a design introduced by Molteno in 1969. The major disadvantage of Molteno implant is early postoperative hypotony with its associated complications such as flat anterior chamber, serous and hemorrhagic choroidal detachments. Modifications in the various implant designs have been developed in attempt to limit the occurrence of postsurgical hypotony. (***El Syyad et al., 1998)***

Currently drainage devices can be divided into two groups, those with valves and those without valves. The non-valved are the various types for ex, Molteno implants, the Baerveldt implant, and the Schocket encircling tube. Valved implants for ex, the Krupin disc and the Ahmed Glaucoma Valve. (***Coleman et al., 1999)***

AIM OF THE WORK

The aim of this study is to discuss different mechanisms of glaucoma implants and their uses for treatment of pediatric and refractory glaucoma.

INTRODUCTION

Trabeculectomy is the most popular form of glaucoma filtration surgery and remains the gold standard for surgical reduction of intraocular pressure in uncontrolled glaucoma with medical treatment. This partial thickness filtration operation decreases eye pressure via the establishment of a limbal fistula through which aqueous humor drains into the subconjunctival space and forming the filtering bleb. The outcome of filtration surgery is highly dependent on the type of glaucoma. ***(Fellman, 1998)***

Trabeculectomy proved to have lower success rates with certain types of glaucomas compared to primary glaucoma. These glaucomas include: neovascular glaucoma, uveitic glaucoma, glaucoma associated with aphakia and pseudophakia and silicone induced glaucoma. ***(Asaad, Baerveldt G & Rockwood, et al., 1999)***

The treatment of glaucoma in childhood is fraught with difficulties, namely, frequent poor response to medical therapy, associated ocular conditions that may worsen the visual prognosis, and inability of the infant and toddler to cooperate with necessary components of the ophthalmic examination. Aqueous shunt devices have been effectively used in the treatment of the pediatric glaucomas.

Glaucoma drainage devices are an option in the management of complicated glaucomas that carry high risk of failure from conventional filtering surgery. Because cyclodestructive procedures carries high risk of atrophia bulbi, many glaucoma surgeons believe that glaucoma drainage devices are good alternatives to cyclodestructive procedures specially in eyes that are visually potential. ***(Lioyd, Baerveldt G, Fellenbaum P et al. 1994 & Hodkin, Goldblall W, Burgoyne C, et al. 1995)***

The most common drainage device in use today is based on a design introduced by Molteno in 1969. The major disadvantage of Molteno implant is early postoperative hypotony with its associated complications such as flat anterior chamber, serous and hemorrhagic choroidal detachments. Modifications in the various implant designs have been developed in attempt to limit the occurrence of postsurgical hypotony. (***El Sayyad, El-Maghraby A, Helal M et al., 1991)***

Currently drainage devices can be divided into two groups, those with valves and those without valves. The non-valved are the various types e.g. Molteno implants, the Baerveldt implant, and the Schocket encircling tube. Valved implants e.g. the Krupin disc and the Ahmed Glaucoma Valve. (***Coleman, Hill R, Wilson R, et al., 1995)***

AIM OF THE WORK

The aim of this study is to discuss different mechanisms of glaucoma implants and their uses for treatment of pediatric and refractory glaucoma.

Anatomy of the angle of A.C.:

The following structures can be identified "gonioscopically" at the irido-corneal angle:

1. **Schwalbe line (anterior border ring):**

Is the most anterior structure, appearing as an opaque white line. This line runs circumferentially round the end of Descemet's membrane, it consists of densely packed collagenous fibres supported with elastic fibres.

2. **The trabecular meshwork (Ligamentum Pectinatum Iridis):**

Extends from Schwalbe line to the scleral spure and has an average width of 600Mn. Gonioscopically, it has a ground-galss appearance and appears to have depth. The anterior non-functioning part lies adjacent to Schwalbe line and has a whitish color. The posterior functioning part lies adjacent to the scleral spur and has agreyish-blue translucent appearance. ***(Tripathi R, Tripathi K, Calman, Adams et al., 1998)***

Structure of trabecular meshwork :

It composed of multilayered sieve like structure, it can be devided into: A) Juxta conalicular tissue: This is the outer most portion of the trabeculae which lies in immediate vicinity of Schlem's canal. It is composed of porous amorphous connective tissue. B) Trabecular meshwork: is composed of branching interlacing beams (trabeculae) that are separated by inter-trabecular space.

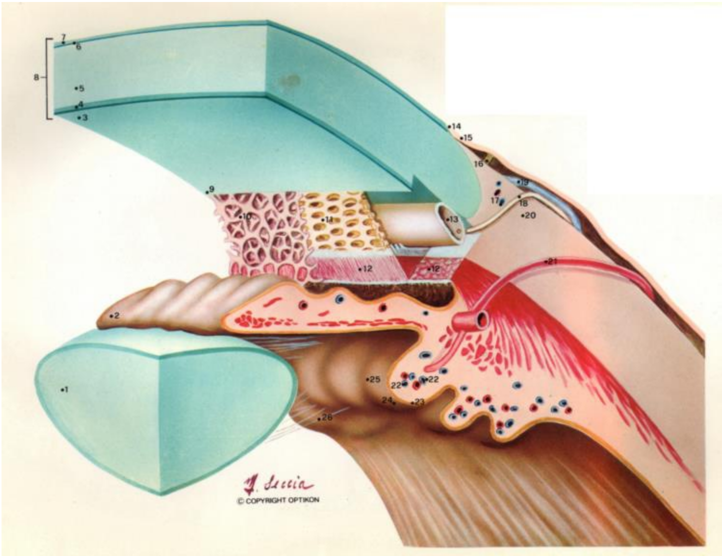

Fig. (1): Anatomy of the angle of the anterior chamber

The trabecular meshwork can be differentiated into: - *uveal meshwork*: lies next to anterior chamber and extends from ciliary body internal to scleral spur to Schwalbe’s line. It has finer, round trabeculae and the stomata between them are large & irrigular. – *Corneo-scleral meshwork*: lies external to uveal portion and extends from scleral spure to schwalbe’s line and disposed flattened bands with numerous oval smaller stomata.

3. The Canal of Schlemm (sinus venosus selerae):

This is an annular vessel which encircle the eye at the bottom of scleral furrow. It occupies the posterior half of the distance between scleral spur & posterior limiting lamina. Throughout most of its course it is single but it may divide into branches which recombines again. It is flattened from without inwards, oval or triangular in shape with its apex toward the cornea. In average, its long axis measures about 0.5mm.

Structure:

The wall of the canal is formed by single layer of endothelium with incomplete or interrupted basement membrane which is surrounded by thin fibrous tissue. The endothelial cells joined side to side by zonule occludents, contains pinocytic vesicles and have microvilli that project into juxtacanalicular tissue from the lumen.

Communications:

- With anterior chamber:. There is no direct communication, however early writers describe direct endothelial channels between anterior chamber and Schlemm’s canal.
- With the venous system: A20-30 collector channels run from the convex outer aspect of the canal at irregular intervals to join intrascleral venous plexus receive also emissary veins from the ciliary venous plexus. This plexus lie just external to the canal and empty into the

episcleral venous plexus and even traverse sclera and in turn into anterior ciliary veins. A few channels bypass the intrascleral plexw and traverse sclera to drain into episcleral & Conjunctival venous plexuses close to limbus. These channels called “aqueous veins” because they contain clear aqueous humour and no blood. ***(Wolff's Anatomy, 1997).***

4. Scleral Spur: (Posterior border ring)

Is the most anterior projection of sclera internal to Schlemm canal. It appears as narrow whitish band posterior to the trabeculae. It is the most important land mark because it has a relatively consistent appearance in different eyes.

5. Ciliary body:

Stands out just behind the scleral spur as a pink to dull-brown to slate-grey band. Its width depends on the position of iris insertion.

The angle recess represents the posterior dipping of the iris as it inserts into the ciliary body.

6. Iris processes:

Are delicate filaments or broader bands that run from trabecular region at level of scleral spur across the angle recess onto anterior surface of iris. They vary in number & so the amount of that angle is hidden varies also.

7. Blood vessels:

Running in aradial pattern at the base of the angle recess are often seen in normal eyes. ***(Wolff's Anatomy, 1997).***

Aqueous humor

The aqueous humor helps to maintain the intraocular pressure and to provide the metabolic needs of the avascular cornea, the crystalline lens, and the trabecular meshwork. It is formed by the nonpigmented epithelium of the ciliary body by active transport (secretion) and by a diffusional exchange (movement of a substance across a membrane along its concentration gradient). Large protein molecule and blood cells are excluded by the blood-aqueous barrier. Specific transport systems of the non-pigmented ciliary epithelium remove organic ions from the posterior chamber. ***(Davson H , 1990)***

Aqueous humor passes from the posterior chamber through the pupil into the anterior chamber. It leaves the eye chiefly through the trabecular meshwork, passing into the canal of Schlemm, and then into the deep scleral vascular plexus.

About 20% drain into the ciliary muscle spaces at the root of the iris and into the suprachoroidal space (the uveoscleral route).

Sodium, chloride and bicarbonate are secreted across the non-pigmented epithelium of the ciliary body, possibly by some unknown linkage. The osmotic forces of these ions in the eye attract water. The non-pigmented epithelium of the ciliary body in many species contains membrane-bound Na, K-Atpase