Viscoelastics in phacoemulsification

Essay
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Introduction

Cataract is the leading cause of blindness in the world: in 2010, an estimated 20 million people were blind due to cataract.Globally, at least 100 million eyes have visual acuity less than 6/60 due to cataract,annually, the need for cataract operations is at least 30 million per year, but only around 10 million cataract operations are performed annually.[1]

Large incision intra capsular cataract extraction or extra capsular cataract extraction with non-foldable, posterior chamber intraocular implantation was the initial surgical technique for cataract extraction, the trend has changed towards using smaller incisions and performing sutureless surgeries as small incision cataract surgery initially followed by phacoemulsification.[2]

Phacoemulsification cataract extraction was first introduced by Charles Kelman in New York in 1968.Hefound that ultrasonic vibrations could be used to emulsify the aged crystalline lens through a very small incision, his pioneering work revolutionized cataract surgery.[3]

Phacoemulsification complications includevitrous loss, posterior capsule tear, zonular dehiscence, iris trauma, hyphaema, nucleus loss, and bullous keratopathy. Incision problems include short corneal tunnel, wound burn, and wound leak.[4]

The ultrasound power necessary for phacoemulsification in routine cataract surgery induces an endothelial cell density loss of 6.3% to 12.8%.Therefore; decreasing endothelial cell loss has become a primary goal in phacoemulsification, especially in patients with a compromised cornea, through decreasing the ultrasound power needed orplacing an inert material between the lens and the corneal endothelium that is not harmful to the internal structure of the eye.[5]

The air-cushion technique was recommended to avoid damage to the endothelial cell during the intraocular surgery, but has the disadvantages of distorting visibility, inadequately maintaining anterior chamber depth and cell dryness if surgery is prolonged.[6]

Viscoelastic substance such as hyaluronic acid have been commonly used to protect the endothelium and to maintain anterior chamber depth since the late 1970's, the major aim for the application of viscoelastic substances in phacoemulsification is to prevent corneal endothelial cell loss, deepening of the anterior chamber, absorption of ultrasound energy, coating of intraocular lens.[7]

The efficacy of viscoelastic solutions or ophthalmic viscosurgical devices (OVD) in ocular microsurgery is due to their rheological properties which depend on the origin of the molecule, the length of the molecular chain and intra and inter-chain interaction.[8]

Viscoelastics are classified into two major categories according to their molecular weight and resting viscosity: High viscosity (cohesive viscoelastic) it is subdivided into super cohesive which have zero shear viscosity in excess of I million Dalton, other type consists of cohesive viscoelastics that have a zero shear viscosity between 100,000 and 1million Dalton. Low viscosity (dispersive viscoelastics)They remain against the endothelial cells extremely well throughout the phaco, because their molecules tend to occupy space by breaking up and dispersion.[9]

Aim of the work

Our work is to review literature about advantages and disadvantages of each type of viscoelastics regarding:

Maintenance of anterior chamber, manipulationof tissues, coating ability, facilitation of implant insertion and corneal endothelium protection, as well the recent advances in viscoelastic materials.

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Anatomy

Anatomy of the anterior segment

General shape and dimensions of the eyeball

The eyeball is made up of segments of two spheres of different sizes placed one infront of the other, the anterior smaller segment, the cornea, is transparent and forms about one-sixth of the eye ball; it has a radius of curvature of 12 mm. Anteriorly, the center of the external surface of the cornea is called the anterior pole. Because the vertical dimension of the cornea is less than the horizontal dimension, this pole is closer to the inferior and superior border of the cornea and farther away from its nasal and temporal border.The anteroposterior diameter of the eye measures about 24mm.Since the eyeball is slightly flattened in a vertical plane, the vertical diameter is about 23mm, the horizontal diameter is about 23.5mm.[10]

The Cornea

The cornea is the transparent front part of the eye that covers the iris, pupil and anterior chamber.It is a powerful refracting surface, providing 2/3 of the eye's focusing power.

Gross anatomy

The cornea is a transparent avascular tissue with smooth convex outer surface and concave inner surface. It is approximately 1mm thick at the limbus reducing to 0.52 mm +\- 0.02 mm centrally. It is the most important refracting surface of the eye, the diopteric power being approximately 43 diopters (D), and numerous refractive surgical techniques rely upon altering the curvature of the corneal front surface.