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OPHTHAMIC VISCOSURGICAL DEVICE PROCEDURES : A MIRACLE TOOL FOR SURGICAL CATARACT MANAGEMENT.

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ABSTRACT

Introduction: Ophthalmic viscosurgical devices have remained an indispensable part of the cataract surgery armamentarium now for decades. Their use has been for forming the anterior chamber and protection of the corneal endothelium. Viscodissection and viscodelineation have been described by authors . We designed a study to evaluate the usefulness of ophthalmic viscosurgical device procedures in our phacoemulsification cases .

Aim: The study documents the use of ophthalmic viscosurgical device procedures as an added step to facilitate cataract removal.

Methods: Twenty five consecutive cases of cataract with nuclear sclerosis one or two withor without any grade of posterior subcapsular opacification were enrolled. The cases were performed by a single operator. Phacoemulsification was performed as per protocol. Ophthalmic viscosurgical device procedures were performed as an additional step. Subjective and objective assessments were done post operatively.

Results: The use of ophthalmic viscosurgical device procedures reduced the total phaco energy used per case.

Discussion: Ophthalmic viscosurgical device procedures are advocated as an adjunct to power modulations to reduce the total phaco energy used per case.

Conclusion: In the era of increasing sophistication ophthalmic viscosurgical device procedures represent an exciting paradigm shift towards minimalization and efficacy.

KEYWORDS : Ophthalmic viscosurgical device procedures; surgical cataract management

INTRODUCTION

Teaching cataract surgery to raw medical students in a regional institute of ophthalmology is both challenging and rewarding at the same time. We do not have the privilege to work with trained post MS fellows and yet again we have the privilege to train the students at the seed stage, to those who are performing cataract surgery for the first time in their life. Our training will bear fruit for the next genre of cataract surgeons.

"The case of a trainee must be as good as that of a consultant". We pledge ourselves to this dictum. Thus our quest for simpler, reproducible ,effective and safe methods of cataract extraction remains a dedicated and ongoing endeavour.

A thorough study of the natural beautiful anatomy of the crystalline lens revealed that the lens is a bag of fibres enclosed by a capsule.

The crystalline lens is a highly ordered structure with a close orderly packing of lens fibre cells. The lens has an elliptical shape and occupies the space between the iris and the vitreous. It is held in a fairly fixed position by the zonular fibres that run from the lens to the ciliary body and by its close approximation to the vitreous on its posterior and equatorial sides. The lens fibres with their highly organized concentric shells make up the bulk of the lens.[1,2]

In infants the cortical lens cells surrounding the fetal nucleus are nucleated. As new cells form the older ones are displaced deeper into the cortex and lose their nuclei. The deeper cells lose their nuclei and their outlines become less defined. By thirty years of age a considerable number of older cells have accumulated to form the lens nucleus. The cells comprising the lens cortex surround the nucleus and many of them retain their nuclei. The cells of the lens cortex and nucleus have come to be known as lens fibres because of their length. [1,2]

It is mentioned that as there is synthesis of secondary lens fibres, cells from the equator migrate towards anterior and posterior poles, pushing the older cells deeper .Thus the lens is formed in concentric layers.[1,2]

The mystery to explain why this beautiful transparent structure becomes opaque may be a wee bit more perplexing. Researchers report that an orderly structure, stable metabolic state and intact antioxidant system are mandatory to maintain clarity.[2]

The above are affected by ageing ,trauma, various metabolic states to name a few.[2]

The resultant opacification of the crystalline lens referred to as cataract is coincidentally the most common cause of blindness worldwide, as reported by the world health organization.[2]

Schell J, Boulton ME observe that the lens epithelium lies under the anterior capsule and at the equatorial bow. The epithelium continues to form new lens cells throughout life albeit at a slower rate as age advances. This leads to increase in lens weight and an increase in its equatorial diameter and thickness in that order. Contrary to other dividing epithelia there is no shedding of the older cells that are internalized. The older fibres are in the centre of the nucleus and the younger fibres are in the outer cortex.[2]

Ageing leads to change in color(more yellow), protein aggregation, increased hardness and decreased light transmission. The resultant lens opacification referred to as cataract ,results in loss of light transmission.[2]

We have observed that the colour of the lens including the capsule ,cortex, epinucleus and nucleus deepens or darkens progressively as we move from anterior to posterior. Authors have observed and correlated the hardness of the lens with its colour.

We were intrigued by the concentric arrangement of the natural lens fibres. The natural cleavage planes are thus concentric. Cleaving the lens along these planes we speculated would be easier and least traumatic. Hydroprocedures and ophthalmic viscosurgical device procedures help cleave the crystalline lens along these natural cleavage planes.

Hydroprocedures are a documented step of phacoemulsification. Fine's cortical cleaving hydrodissection is in the plane between the cortex and the capsule. [3,4] There is a plane between cortex and nucleus seen as a dark zone in early nuclear sclerosis grade one and two cataracts. Definite mention has not been made of this zone in texts. A plane of fluid wave has to be passed in this zone. There is another dark zone between the epinucleus and the endonucleus. A fluid plane is also created in this zone. Within the endonucleus too there are concentric arrangement of lens fibres which may be cleaved by planes of fluid.

The term hydrodelineation was introduced by Anis to describe the act of separating an outer epinuclear shell or multiple shells from the compact inner nuclear material,the endonucleus by forceful irrigation of fluid into the inner nuclear mass.[3,4]

It has been our observation that although the cortex, epinucleus and endonucleus are concentric still the posterior cortex, epinucleus and endonucleus are browner than the anterior counterparts as if we could draw a vertical line from the superior equator to the inferior equator to divide the lens into two zones , an anterior softer zone and a posterior harder zone. We also observed that not only the nucleus colour but also the compactness of the lens matter observed on slit lamp biomicroscopy may contribute to its hardness.

In phacoemulsification after capsulorrhexis we remove the anterior cortex ,epinucleus and superficial endonucleus by aspiration alone and it comes easily.The posterior endonucleus, epinucleus and cortex are left. The posterior endonucleus (the core lens matter) is held with the phaco probe and alternately vertically chopped and emulsified. The softer lens layers are the gripped and emulsified/aspirated layer by layer. The remaining cortex is removed by irrigation- aspiration.

In addition to hydrprocedures we contemplated using ophthalmic viscosurgical devices to cleave the lens in a way similar to hydroprocedures. This has been described by various authors. The technique was particularly useful in posterior subcapsular and posterior polar cataracts with minimal nuclear sclerosis (nuclear sclerosis one to two). Hydroprocedures were performed. Ophthalmic viscosurgical devices (dispersive type) were then used in a manner similar to the hyroprocedures.

In nuclear sclerosis one to two the loosened nuclear shells could be removed by ophthalmic viscosurgical device delivery alone. Only the cortex was required to be removed by irrigation aspiration. In posterior polar cataract cortical cleaving hydrodissection and ophthalmic viscosurgical device dissection was reserved till sfter intraophthalmic lens implantation was done.

Hydroprocedures and ophthalmic viscosurgical device procedures drastically reduce the nucleus size for phacoemulsification. It therefore reduces phaco time and thereby decreases ensuing damge to the corneal endothelium.

A compact nucleus is loosened up so that it can be easily emulsified as a soft cataract. At times we were surprised that the whole cataract could be removed by aspiration alone. This was seen in lower grades of nuclear sclerosis.

It has been our observation that in phacoemulsification many layers of hydrodelineation help in naturally cleaving the natural crystalline lens layer by layer. Subsequent emulsification of each layer is easy. The remaining epinuclear and cortical plate is easy to remove by repeating hydrodissection or hydrodelineation as required. This increases safety levels as there is always a plate of epinucleus to protect the posterior capsule. We have found this to be a safe method for early cataracts as nuclear sclerosis one and two grade as well as posterior polar cataract. This method has been documented for posterior polar cataracts but not for nuclear sclerosis type of cataracts.

Even in higher grades of nuclear sclerosis ophthalmic viscosurgical device delineation loosened up the harder nucleus so it could be emulsified with relative ease with excellent postoperative results. As we followed the natural cleavage planes of the crystalline lens the posterior capsule was well protected till the end giving us a great safety level and a postoperative vow factor.

In the era of ongoing sophistication in cataract removal methods involving newer and dearer machines ,we go back to the basics and present an effective, safe , repeatable, accessible and universal miracle tool for surgical cataract management in the form of integrated hydroprocedures and ophthalmic viscosurgical device procedures.

METHODS

Twenty five consecutive cases of cataract with nuclear sclerosis one or two withor without any grade of posterior subcapsular opacification were enrolled. The cases were performed by a single operator. Phacoemulsification was performed as per protocol. Phacoemu lsification was carried out from the temporal approach. Wound construction and capsulorrhexis were done. Hydrdissection was done except in cases of posterior polar cataracts. This was followed by hydrodelineation in as many planes as possible.

Once fluid has cleaved the natural concentric planes we injected ophthalmic viscosurgical devices in the same plane. This is followed by delivering the soft and loose lens matter by injecting ophthalmic viscosurgical device at six o' clock and then slowly withdrawing the cannula while still injecting ophthalmic viscosurgical devices.

We used dispersive ophthalmic viscosurgical device(hydroxypropyl methyl cellulose) in a 5 ml syringe on a 27 gauge canula .

The remaining nuclear matter is phacoemulsified. The remaining cortical matter is removed by irrigation aspiration. Posterior chamber intraophthalmic lens is implanted. Ophthalmic viscosurgical device wash and closure are done.

Total ultrasound energy required for nuclear disassembly following viscodelineation was noted. This was compared with the total ultrasound energy required with conventional ultrasound phaco surgery.

Subjective and objective assessment of the patient was done first day, one week, six weeks postoperatively.

RESULTS

We were surprised to observe that a case of traumatic posterior polar cataract with minimal nuclear sclerosis could be managed by ophthalmic viscosurgical device alone. The nucleus , epinucleus as well as the cortex came out in layers with viscodelineation. Intraophthalmic lens was implanted. The capsular bag was cleaned with irrigation and aspiration mode of the phaco machine.

There was a posterior capsular plaque which was peeled off the posterior capsule with the help of a capsulorrhexis micro-forceps. The cornea was clear on the first postoperative day.

In other cases of nuclear sclerosis grade one/two; two/three the nucleus could be reduced to fifty to thirty percent of its original size via ophthalmic viscosurgical device procedures and ophthalmic viscosurgical device removal.

The remaining small denser central nucleus could be very readily directly chopped and emulsified.

This reduced the phaco energy to a minimum . The cornea was absolutely clear on the first postoperative day with minimal intraocular inflammation and normal intraocular pressures.

DISCUSSION

This represents an exciting paradigm shift. In the era of incessant advent of newer and better machines to remove this simple crystal bowl ,we take a u turn and go back to simpler readily available, safe viscosurgical devices with minimal learning curve to manage this opacified crystalline lens .

Hydrodissection traditionally meant the injection of fluid into the cortex to separate the nucleus from the cortex and the capsule. Following the introduction of continuous curvilinear capsulorrhexis ,hydrdissection became a critical step to mobilize, disassemble and remove the nucleus. Fine described the cortical cleaving hydrodissection designed to cleave the cortex from the capsule and break any cortico capsular adhesions .[3] This left the cortex attached to the nucleus. The nuclear cortical complex was now free to rotate within the capsule, a critical step in phacoemulsification.

Packer additionally elaborates hydrodelineation which separates the epinucleus from the endonucleus .[4] The epinucleus keeps the capsular bag on a stretch and provides a protective cushion for phacoemulsification.

This is followed by nucleofractis of the endonucleus within the protective shell of the epinuclear-cortical complex while keeping the capsulorrhexis intact.

Nucleofractis of the endonucleus is done by phacoemulsification using phaco power.

Fine described that reduction of ultrasound energy by the use of power modulations resulted in superior uncorrected visual acuity on the first post operative day.[3]

We offer ophthalmic viscosurgical device procedures as an adjunct to power modulations to reduce ultrasound energy usage. The procedures complement the current phaco steps and are not an attempt to disqualify any of the existing surgical techniques.

We have elaborated hydroprocedures as a means for reducing the size of the endonucleus. It has been our observation that in phacoemul sification many layers of hydrodelineation help in naturally cleaving the natural crystalline lens layer by layer. Subsequent emulsification of each layer is easy. The remaining epinuclear and cortical plate is easy to remove by repeating hydrodissection or hydrodelineation as

required. This increases safety levels as there is always a plate of epinucleus to protect the posterior capsule. We have found this to be a safe method for early cataracts as nuclear sclerosis one and two grade as well as posterior polar cataract. This method has been documented for posterior polar cataracts but not for nuclear sclerosis type of cataracts.

The ophthalmic viscosurgical device procedures in addition to reducing the size of the endonucleus also reduce its compactness to some extent.

Salahuddin A reported controlled hydrodelineation, viscodelineation and viscodissection with minimal stress on the posterior capsule for the management of posterior polar cataract. He reports it as the inverse horse shoe technique of phacoemulsification.[5]

We report ophthalmic viscosurgical device procedures as an addition to phacoemulsification power modulations to decrease the total phaco energy dissipated into the eye for posterior polar and early nuclear sclerosis cataracts.

Further research is required to document the procedures for denser grades of nuclear sclerosis cataracts.

CONCLUSION

In the era of increasing sophistication ophthalmic viscosurgical device procedures represent an exciting paradigm shift towards minimalization and efficacy.

What was Known

- Ophthalmic viscosurical devices have been used in cataract surgery and phacoemulsification for forming the anterior chamber and protecting the corneal endothelium.
- Viscodissection has been described for removal of residual cortical matter.
- As per our knowledge only one author reports hydrodissection, viscodissection, viscodelineation for the management of posterior polar cataracts.

What this article adds

- Ophthalmic viscosurgical devices may also be used for cleaving the cataractous lens along its natural concentric cleavage planes.
- The article documents the usefulness of ocular viscosurgical device procedures i.e. viscodissection and viscodelineation for early nuclear sclerosis and posterior subcapsular type of cataracts also.
- The procedures in addition to safeguarding the posterior capsule also reduce the total phaco power used per case thus enhancing safety and efficacy.

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