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# ADVANCAED CATARACTS SAFE SURGICAL TECHNIQUES FOR SAFE OUT COME

Ophthalmology

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## ABSTRACT

**Introduction:** Advanced cataracts like Morgagnian hyper mature, Shrunken or sclerotic and Cataracta Nigra require proper pre operative evaluation which anticipates and avoides Intra Operative surprises. The aim of study is to minimise Intra Operative and thereby postoperative complications by adequate preoperative evaluation and to assess the effectiveness of various techniques rather than following standard surgical procedure. Selecting appropriate operative steps suitable to that particular type of cataract in its advanced stage protects cornea and posterior capsule so that good visual out come, minimal recovery period, and a better quality of life can be given. One must be familiar with various operative techniques of cataract surgery. Sometimes advanced procedures like Phaco, MICS, may not be suitable especially in cases like Cataracta Nigra though the surgeon is familiar with. To achieve good visual outcome various modified techniques are applied.

**Material and Methods:** In this Prospective, hospital based study of 9 months from August 2016 to April 2017, 30 patients (30 eyes) aged 50 years or older attending the General Ophthalmic department are included in the study group with another group of 30 patients (30eyes) as controls. The study is on age related cataracts in advanced stage which are basically. 1) Morgagnian hypermature cataract 2) Hyper mature Shrunken cataract and 3) Cataracta Nigra.Technicques like Large Incision Nuclear Expression Cataract Surgery/ Small Incision Nuclear Expression Cataract Surgery, Continuous or discontinuous capsulotomy by means of cutting with Vanas scissors, sphincterotomy for small and rigid pupil are applied whenever necessary in study group rather than only SICS in control group. Eyes with pseudoexfoliation having poor pupillary dilation are also included. Eyes having phacodonesis, congenital anomalies, congenital cataract, gross corneal and retinal pathologies, glaucoma and other ocular co morbidities are excluded.

**Results:** In control group complications like iridodialysis(6.66%), hyphema (13.33%), broken nucleus(10%),vitreous presentation(16.66%) are observed. Post operatively there is striate keratopathy(33.33%), severe inflammatory reaction(20%), hyphema(6.66%). 2(6.66%)eyes developed corneal endothelial decompensation for which keratoplasty advised .The final visual out come is satisfactory in 66.66% of cases only. In study group major complication we have come across intra operatively is posterior capsule rent in 1(3.33%) eye where we could able to implant AC IOL (3.33%). Complications like mild striate keratopathy in 2(6.66%) eyes and mild to moderate inflammatory reaction in 4(13.33%)eyes managed well. The final visual out come even in eye having AC IOL is 6/9 - 6/6 with correction in all(100%) cases.

**Conclusion:** Cataract in advanced stage can be prone for pre, intra and postoperative complications. Modern procedures like Phacoemulsification, manual SICS, and MICS may not give good results.One must be familiar with several techniues.

## KEYWORDS

Morgagnian cataract, SICS, Capsulorrhexis, sphincterotomy, iridodialysis.

**Introduction:** Age ralated Cataract is a progressive increase in lens opacification which deteriorates quality of retinal image and thereby reducing visual acuity. The lens is exposed to cumulative effect of Radiation, oxidation and post translational modifications throughout life. Alfa,Beta and Gama crystallines are major proteins contributing towards the maintenance of lens transperancy during aging. Alfa crystallines which are members of Heat-Shock protein family act as molecular chaperones by binding to partially denatured proteins thereby preventing irreversible protein aggregation during aging. Change in distribution of lens chaperones during aging and also decreased ability of the alfa crystallines to act as chaperones in response to UV radiation during aging have effects on age related cataract formation[1].

Age related cataracts are basically Cortical, Nuclear, and posterior sub capsular.Cortical cataract progresses from stage of lamellar seperation to incipient, immature, mature and hypermature stage. In hypermature stage lens can be Morgagnian type or shrunken type[2].In Nuclear cataract there is progressive increase in sclerotic process. Advanced cataracts commonly we come across in advanced age groups of poor socioeconomic status, neglect of eye when fellow eye is pseudophakic or when patient is not ambulatory . In nuclear sclerosis the color of the lens slowly changes from yellow to amber, reddish, brown and finally it may become almost black. This occurence was called CATARACTA NIGRA by WENZEL(1786) AND CATARACTA BRUNESCENS by BECKER(1883)[3]. Dehydration and compaction of the nucleus are associated with development of nuclear sclerosis(4). In maturity the sclerosis may extend almost to the capsule so that the entire lens function as a nucleus. Due to deposition in the lens of yellow pigmented protein derived from amino acid Tryptophane altered by the action of sun light it tinted lens from dark brown ,dusky red and even black in nuclear sclerosis[2].

**Materials and Methods:** We studied prospectively for a period of about 9 months i.s.from August 2016 to April 2017 a series of 30 eyes in study group and another 30 in control group , to identify and avoid various problems related to advanced cataract surgical management.It is a randomised comparative controlled study. Patients recruited in the study are diagnosed as having advanced cataract either in Hypermature stage or Black sclerotic cataract. Above 50 years of age patients are recruited in the study.**( Table1)**

The study is approved by our institutional committe board .Written and Informed preoperative consent taken for all cases.The study is on age related cataract in advanced stage basically 1) Morgagnian hypermature cataract 2) Hyper mature Shrunken cataract and 3) Cataracta Nigra . Pupillary examination to know the status of pupil (dilating satisfactorily or not) is also included in the criteria . Eyes with pseudoexfoliation (PXF) having poor pupillary dilation and senile miosis are also included. Eyes with phacodonesis, congenital anomalies, congenital cataract, gross corneal and retinal pathologies, and glaucoma are excluded. Visual acuity ranged from counting fingers close to face to Light Perception and Projection.

Pre operative assessment of cataracts may aid planning of surgical approach to individual cataracts. Slit lamp biomicroscopy is the major method used to assess and observe cataracts[5]. Several subjective and objective methods have been developed to assess cataract accurately both in vitro and in vivo. Smith et al published their finding of a highly statistical significant relationship between opalescent quality and color of lens nucleus on the mechanical compression character of cataractous lens. As the opalescence and color increase so does the hardness of the nucleus. Lens Opacity Classification system (LOCS)111 grading rule which is a subjective classification is followed while Grading cataract. Cataracts are graded at slit lamp with respect to Nuclear opalescence (NO standards are 1 to 6),Nuclear Color (NC standards are1 to 6),Cortical cataract (C standards are1-6),and Posterior cataract(P standards are1to 5). A lens is classified as mature if there is no recognisable normal anatomic zones and hypermature if in addition there is swelling of lens.The final stage of

Brown plaque like nuclear mass is often termed Black cataract and its large size and inability to mould may cause difficulties during extraction[5].

Well-dilated pupil with a sharp red reflex enhances the ease of cataract extraction .The ability of the pupil to dilate adequately should be estimated before surgery[6]. As age progresses pupil may become miotic and dilate poorly. Not only senile miosis, senile exfoliation is also other cause for poor pupillary dilation found .In advanced cataracts because of poor or absent fundal glow there is difficulty in preoperative fundus evaluation.

Among 30 study group we selected 10 cases of purely Morgagnian hypermature cataract,10 cases of hyper mature Shrunken cataract, and another 10 cases of purely nuclear black cataract . Control group also selected accordingly .

All surgeries are performed by one surgeon under Peribulbar Anaesthesia .

**Preoperative examination criteria:** Age 50yrs and above, gender, visual acuity, and type of cataract are noted. Slitlamp examination, IOP measurement, pupil reaction, B-scan & A-scan biometry, keratometry, and proper management of systemic diseases like diabetes ,hypertension, asthma and cardiac evaluation by concerned specialists done. 3:2(F:M) is the gender ratio observed. As cataract is advanced and fundus is not seen surgical risk explained to each patient and informed consent taken from each one . A problem arises if potential material risks and dangers are not disclosed to a patient before surgery and a complication occurs[7].

All belong to Poor socio economic status . Most of their occupation is farm industry.

**Table1**

| Age group | No. of patients in study group | No. of patients in control group |
|---|---|---|
| 50 - 59 | 15 | 18 |
| 60 - 69 | 11 | 10 |
| More than 70 | 4 | 2 |

**Slit lamp observations:** As all patients are in elderly age group Arcus senilis is observed with few patients having peripheral mosaic degeneration. Anterior Chamber depth is normal to deep

Iris color & pattern is normal except one case in study group and 2 cases in control group where it is thick and hyperpigmented.

Pupillary size , reaction and dilation is adequate in 15(50%) eyes in study group and 17(56.66%) eyes in control group. 8 (26.66%)%) in study group 9(30%)in control group have small pupils ,their dilatation with mydriatic is also poor due to pseudoexfoliation. Senile miosis is seen 7 (23.33%) in study group and 4(13.33%) in control group. Pupil of size 6mm or less than 6mm is considered as abnormal **(Table:2)**

**Table:3**

| Pupils dilatation | Study group | control group |
|---|---|---|
| Good | 15 | 17 |
| Small pupil due to | | |
| A) pseudoexfoliation | 8 | 9 |
| B) senile miosis | 7 | 4 |

In Group 1 of study and control eyes Milky white lens with floating nucleus is seen and considered as Hpermature Morgagnian type of cataract .Another varient is Hypermature cataract having shrunken and wrinkled capsule(8). White shiny wrinkled capsule with calcified deposits on its anterior surface is seen in shrunken hypermature cataract in group 2. In group 3 pupil appeared black on oblique illumination a circumstance which make the conditon resemble the effect of massive hemorrhage into vitreous body(3). Careful examination and biometry scanning done to exclude the above condition and case considered as black cataract.**(Table3)**

**Table3**

| Cataract grade | Study | Control |
|---|---|---|
| Morgagnian hypermature | 10 | 10 |
| Shrunken hypermature | 10 | 10 |
| Cataracta nigra | 10 | 10 |

The attempt of ophthalmologist to predict the visual potential of eye with advanced cataract is not simple. The surgeon should suspect the added factor of Macular dysfunction[ 9].We could able to assess the visual acuity by means of perception and projection of light, two light point discrimination, color vision testing, entoptic visualisation.

Visual Acuity ranged from hand movements to Perception and Projection of light. Fundus examination is not possible due to advanced cataract stage. B-scan performed in all cases. Keratometry and A-scan biometry done for IOL power calculation. In all cases sac infection ruled out.

**Preoperative preparation**: The eye marked , informed consent taken. Topical and systemic antibiotics along with anti inflammatory eye drops day before and on the day of surgery given. Pre oprative topical NSAIDs are used to prevent pupillary miosis, to reduce surgically induced inflammatin, and to prevent post operative cystoid macular edema[10] . Povidone iodine 5% drops instilled 30 mts before surgery .

IOP kept under teens with oral acetazolamide 250 mg at night & 2hrs before surgery. Peribulbar block with infiltration of xylocaine2% combined with Bupivacaine 0.5%, Adrenalin 1 in 200,000 and Hyaluronidase at 7.5 turbidity units/ml as local adjuncts are given to achieve good anaesthesia. Pressure not applied over the eye as there is chance of zonular disrruption.

**planning the incision and surgical strategies:** The final part of patient work for cataract surgery is planning the incision which involves the optimal position of operative incision in relation to the surgical accessibility(type of cataract, pupil dilation, globe position) for efficient execution of surgery.The common approach is Extra Capsular Cataract Extraction. Type of incision whether Large Incision Nuclear Expression Cataract Surgery/ Small Incision Nuclear Expression Cataract Surgery is decided on type of advanced cataract[11] in study group . Attempts to deliver lens through an inadequate pupillary opening are fraught with danger of capsule rupture and loss of vitreous[9].To prevent Intra Operative miosis, non preserved epinephrine (1:1000)0.5ml/500ml is the most frequently used additive[10]. Standard SICS incision parameters are followed in control group for all variants of advanced cataract. In study group of cataracta nigra with or without adequate pupil dilation the type of incision to be given is decided on the table i.e whether SICS with more than 7 mm external incision and just less than 1mm behind limbus having Internal incision given is about 8-9 mm and parallel to limbus or conventional ECCE incision at limbus. For Morgagnian and shrunken cataracts SICS is opted . Capsulotomy technique followed is either Can open or CCC of size ranged from 6 - 6.5mm with radial cuts at the rim margin . Efforts made to keep the capsular rim near 12 o clock position narrow. 2 to 3 relaxing cuts are given to capsular rim between 11 to 1 clock hours and at 7 o clock in cases where there is big nucleus with inadequate pupillary dilation for easy prolapse of nucleus as well as for sub incisional cortical aspiration . In case of Morgagnian hypermature cataracts small nic given over centre of anterior capsule so that liquefied cortex can be aspirated . Later capsulotomy completed by carefull CCC . When the anterior capsule is calcified or thickened, capsule is cut with Vannas capsulotomy scissors after making small entry with 26 G cystitome and after tunnel extension. The whole nucleus is gradually rotated into anterior chamber by cart wheeling in a clock wise or anti clock wise fashion. Nucleus delivered under visco or sandwithch technique. Cortex aspirated totally with Simcoe irrigation aspiration cannula. Tunnel closed after placing PC IOL. Sutures applied where ever necessary. Sub conjenctival gentamycin and decadran given at the end.

**Intra operative difficulties: ( Table 4)**

**Table 4**

| Operative difficulties | No. In study | No. In controls |
|---|---|---|
| Small Incision Nuclear Expression Cataract Surgery | 21(70%) | 30(100%) |
| Large Incision Nuclear Expression Cataract Surgery(scleral) | 3(10%) | ---- |
| Limbal approach | 6(20%) | ---- |

| | | |
|---|---|---|
| capsulotomy completed with cystitome and vanas | 15(50%) | ---- |
| capsulotomy completed with cystitome | 15(50%) | 30(100%) |
| zonule dehiscence while doing capsulotomy leading to vitreous presentation | ---- | 5(16.66) |
| sphincterotomy | 4(13.3%) | ---- |
| difficulties while managing nucleus | | |
| sphincter tear | ---- | 4(13.3%) |
| Broken nucleus | ---- | 3(10%) |
| Pc rent | 1(3.33%) | 3(10%) |
| iridodialysis | ---- | 2(6.66%) |
| Tunnel conversion | --- | 4(13.3%) |
| vitreous prolapse and anterior vitrectomy | 1(3.33) | 5(16.66%) |
| Hyphema | ---- | 4(13.3%) |
| Descemets separation | ---- | 6(20%) |
| IOL implanted PC IOL AC IOL | 29(96.66%) 1(3.33%) | 26(86.66%) 3(10%) |
| eye made aphakic | ---- | 1(3.33%) |

Capsulotomy: Complications faced while doing capsulotomy among control group are zonule dehiscence, capsule tear extension, posterior capsule rent, vitreous presentation, partial capsulotomy. With proper assessment and care we could able to succeed in preventing the above complications among study group

Incision approach, improper capsulotomy, inadequate pupil dilation and big nucleus are the main causes for getting more intra operative complications and thereby postoperative complications among control group.

Nucleus prolapse and nucleus delivery: This surgical step is the difficult part especially in Black cataract where several intra and post operative complications occured among control group . Especially in Cataracta Nigra, and eyes having inadequate pupillary dilation capsulotomy could not be done satisfactorily . Intra Operative complications like, zonule dehiscence 5(16.66%), capsule tear extension 4(13.33%), posterior capsule rent 3(10%), tunnel conversion 4(13.33%) , broken nucleus 3(10%), vitreous prolapse thereby difficulty in aspirating cortical matter 5(16.66%), Descemets separation 6(20%), irido dialysis 2(6.66%), bleeding in anterior chamber 4(13.33%), sphincter tear 4(13.33%)and inability to place PC IOL 4(13.33%) as well as AC IOL 1(3.33%) occured among control group . Also there is improper placement of sutures at the end due to tunnel conversion . Finally the duration of surgery is much longer and apprehension on the surgeons part is much high. These difficulties are over come by timely intra operative judgement like incision approach, achieving adequate pupil size by means of stretching pupil or doing multiple sphincterotomies if pupil/lens size ratio is high, doing careful capsulotomy and cutting thickened capsule with Vanas scissors. In one eye because of poor pupillary dilatation and high pupil/lens size ratio posterior capsule rent occured. Intra cameral carbachol 0.01% given for rapid miosis(10). Anterior vitrectomy done under visco injection. Two peripheral button hole iridectomies done . AC IOL placed. Proper placement of sutures by 10-0 nylon can be achieved at the end.

**post operative complications:** On the first postoperative day uncorrected visual acuity and pin hole visual acuity are determined in both the groups and all patients are graded for corneal edema from 0 -3 as none, mild (Descemet folds only), moderate (stromal edema with Descemet's folds), and severe (stromal and epithelial edema).AC inflammation is evaluated by estimating number of cells in a 1mm by 1mm slit beam field and was graded from 0 to 4 as per standard grading parameters. Among study group minimal Striate keratopathy noted in 2(1.6%) eyes which are of Cataracta Nigra . Mild to moderate inflammatory reaction seen in 4(13.33%)eyes .The above complications managed with frequent instillation of topical prednisolone acetate 1% eye drops and cycloplegics. Round pupil maintained in 26(86.66%) cases. Pupil is irregular in 2(6.66%) cases due to multiple sphincterotomies done for eyes having small pupil and big nucleus. Post operative visual acuity is 6/12 to 6/6 in all cases(100%) at 6 weeks follow up.

In control group moderate to severe striate keratopathy observed in 10(33.33%) eyes because of difficulty in prolapse and delivery of big nucleus, Descemets tear, anterior vitrectomy for vitreous prolapse as well as prolonged aspiration time. Post operative hyphema observed in 2 (6.66%)eyes having Intra Operative iridodialysis . Irregular pupil is seen in 6 (20%)cases due to poor mydriasis in 2(6.66)cases, high lens to pupil size ratio in 3(10%) cases and due to accidental pupil damage while doing anterior vitrectomy in 1(3.33%)eye . Retained lens matter observed in 2(6.66%) cases due to difficulty in aspiration due to vitreous disturbance. Post operative hyphema(26.66%), irregular pupil (20%), Severe inflammatory reaction(20%), Descemets separation(26.66%) are other complications observed. Postoperative astigmatism is high as well as irregular in 9(30%)cases. 6/9 to 6/6visual acuity could be achieved in 20 (66.66%)cases. **(Table5)**

**Table5**

| | No. In study | No. In controls |
|---|---|---|
| Striate keratopathy | 2 (6.66%) | 10 (33.33%) |
| Hyphema | — | 2(6.66%) |
| Irregular pupil | 2 (6.66%) | 6(20%) |
| | --- | 3 (10%) |
| Lens matter | 1 (3.33%) | 2 (6.66%) |
| uveal inflammation mild to moderate moderate to severe | 4(13.33%) --- | 2 (6.66%) 6(20%) |
| Descemets separation | --- | 8 (26.66%) |
| Postoperativevisual acuity on 1s pod | 6/12 to 6/9 24(80%) | Cf 4 mts. to 6/60 in 8 (26.66%) |
| Final VA at 6 wks6/9-6/6 | 30 (100%) | 20(66.66%) |
| Astigmatism- irregular | 1(3.33%)) | 9(30%) |
| corneal endothelial decompensation | ----- | 2(6.66%) |

**Results:** Among 30 cases operated in study group major complication we have come across is posterior capsule rent in 1(3.33%) eye inspite of timely intervention techniques. Pseudoexfoliation with high pupil/lens size ratio might be the cause for the complication . In that 1(3.33%)eye AC IOL implanted . Complications like striate keratopathy in 2(6.66%)eyes and mild to moderate inflammatory reaction in 4(13.33%)eyes are managed with frequent instillation of topical prednisolone 1% eye drops and cycloplegics. The final visual out come even in eye having AC IOL is 6/9 - 6/6 with correction in all 30(100%) eyes.

Among control group several intra operative complications like zonular dehiscence while doing capsulotomy 5(16.66%), broken nucleus 3(10%), pc rent 3(10%),iridodialysis2(6.66%), vitreous prolapse and anterior vitrectomy 5(16.66%), hyphema 4(13.33%) ,Descemets separation 6(20%) occured . In 26 (86.66%)eyes PC IOL implanted where as in 3 (10%)cases AC IOL implanted because of posterior capsule rent. One (3.335)eye left with aphakia because of surgeons lack of experience in scleral fixated IOL. Postoperatively also there is moderate to severe striate keratopathy in 10(33.33%) eyes, Hyphema in 2(6.66%)eyes, irregular pupil in 6(20%) eyes , severe inflammatory reaction in 6(20%), Descemets separation in 8(26.66%), retained lens matter in 3(10%) and endothelial decompensation in 2(6.66%)eyes . 6/9-6/6 visual acuity could be achieved in 20 (66.66%)cases. 8 (26.66%)eyes have visual acuity between CF 4 mts - 6/60 . 2 (6.66%)eyes having endothelial decompensation referred for Keratoplasty.

**Discussion**: Managing advanced cataract is a big task to a surgeon. Different medical conditions or pathological states of the eye and the lens may favour one technique over the another .The ability of equipment, as well as level of training of the surgeon may be factors that dictate technique. Status of cataract determine the choice of surgical technique[11].

On one end capsulotomy related problems are high in cortical Morgagnian and shrunken cataracts among control group. Due to its thickend and slippery nature attempts to make CCC lead to zonule dehiscence and vitreous presentation.The sclerotic process render the lens inelastic and hard and decreases its ability to accommodate[4]. The above nature of nucleus lead to Intra Operative comlpications like nucleus break up, PC rent, iridodialysis etc, among control group because of inadequate surgical planning techniques.

Advanced techniques like SICS, Phacoemulsification, or MICS have had limitations while managing advanced cataracts.

Several difficulties faced among control group are due to improper pre operative, and intra operative cataract assessment. Throughout procedure careful judgement is needed. The surgeon can not simply ignore the incision approach , pupil size, and perform the manoeuvers like cutting thickened capsule, stretching of pupil, multiple sphincterotomies. lack of awareness may result in inadvertent complications like zonule dehiscence, capsule tear extension, posterior capsule rent, tunnel conversion, broken nucleus, vitreous prolapse thereby difficulty in aspirating cortical matter, Descemets separation, iridodialysis, bleeding in anterior chamber, sphincter tear inability to place PC IOL as well as AC IOL .There may be Iris & pupillary damage there by round pupillary contour is not maintained postoperatively. Gross corneal haze due to endothelial decompensation and its late consequences, post operative hyphema, irregular pupil, severe inflammatory reaction, Descemets separation lead to poor visual outcome after 6 weeks followup. Complications that occured intra operatively in control group such as nucleus prolapse and expression, conversion of tunnel, sphincterotomy though managed successfully there is unsatisfactory postoperative visual out come . Descemets separation is more among control group. In Mature and hyper mature cataracts due to its slippery nature CCC may not always be uniform. We may need fine angled scissors to cut and complete rhexis via tunnel. Cases of very dense and brunescent cataracts require large capsulorrhex to perform manoeuvers required to minimise complications . As expected post operative astigmatism is little high in groups where Large Incision Nuclear Expression Cataract Surgery is done. But astigmatism is regular in study sroup. Irregular astigmatsm observed is high among control.

**Conclusion**: Our study concludes that the indications for the techniques Large Incision Nuclear Expression Cataract Surgery/ Small Incision Nuclear Expression Cataract Surgery relate to type of advanced cataract. Socioeconomic factors and instrumentation availability, together with surgeons experience also play a significant part in the choice .Discontinuous capsulorrhexis and inadvertent anterior radial tears or posterior capsule tears can cause vitreous presentation and unwanted IOLcomplications. The execution of surgery in the safest possible way in the prevailing circumstances in order to minimise complications (sterility, incision creation and location, wound closure, perioperative antibiotics, surgical technique etc,) minimises operative time[11]. Ensuring the best combination techniques provides the optimal solution for the patient and that includes maintaining the ability to readdress non optimal outcomes. The management of astigmatism in lens surgery has become an essential and integral part of the execution of the operation.

Visual acuity is only one measure of the functional success of cataract surgery. Prospective studies using these tools show that patients who undergo cataract surgery have significant improvement in many quality of life parameters, including performance of community and home activities ,mental health during ability,and life satisfaction[12].

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