Original Article

Phacoemulsification in Senile White Mature Cataracts

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Purpose: To evaluate the intraoperative difficulty, complications and post-operative outcome in patients with white mature cataracts undergoing phacoemulsification.

Study Design: Interventional case series.

Place and Duration of Study: Ophthalmology department of Holy family hospital, from January 2017 to June 2017.

Material and Methods: Fifty Patients who had senile white mature cataract were enrolled in this study. Detailed preoperative and intraoperative notes were taken. A small capsulorhexis was attempted initially after staining the capsule with trypan blue. An initial cut was made with cystotome and it was enlarged with utrata forceps. Phacoemulsification was done with stop and chop technique. Intraoperative difficulties related to continuous curvilinear capsulorhexis, phacoemulsification and post-operative visual outcomes were analyzed. Post-operative examinations were done at day 1, 1 week, 1 month and 3rd month.

Results: There were 28 males (56%) and 22 females (44%). The mean age was 63.18 ± 7.997. The mean preoperative best corrected visual acuity (BCVA) was 0.0276 ± 0.013 with Snellen chart, (0.01-0.05) and mean post-operative BCVA was 0.638 ± 0.305 (0.1-1.0). Mean phaco time was 4.08 ± 1.03 minutes (2.08-6.66). Posterior capsular rupture occurred in 3 (6%) and vitreous loss occurred in 1 (2%) patient. 5 (10%) cases were converted to extracapsular cataract extraction (ECCE). Postoperatively, 10 (20%) patients had transient corneal edema, 3 patients (6%) had persistent corneal edema and corneal burn treated with steroids and hyper osmotic agents.

Conclusion: White mature cataract is a challenge for cataract surgeon, yet by means of additional dyes and proper techniques and expertise, the rate of complications during phacoemulsification can be reduced.

Key Words: Phacoemulsification, Cataract, Trypan blue, Posterior capsular rupture, Corneal edema.

Cataract is the most frequent treatable blindness worldwide. In developing countries, white mature cataracts are seen very frequently[1]. In Pakistan, the most common cause of blindness and low vision is an un-operated cataract. A review conducted in Pakistan yielded prevalence of

1.78% and found out that cataract is a major cause of treatable blindness constituting 66.7% of total blindness. Mature and hypermature cataracts constitute a major volume of surgical load[2].

Surgical removal of white mature cataracts presents special challenges to the surgeon. It is associated with high rate of intraoperative and postoperative complications; such as incomplete CCC, radial tears in anterior capsule extending to equator and posterior capsule, rupture of posterior capsule, vitreous loss, nucleus drop, IOL dislocation, corneal burns, IOP rise, persistent corneal edema and anterior chamber reaction[3-5]. Continuous curvilinear capsulorhexis and emulsification of hard nucleus are two critical steps that make phacoemulsification challenging in these cases. Visualization of the anterior capsule depends on red reflex, which is compromised in eyes with white mature cataract. The capsule is extra fragile and seepage of liquefied cortical material causes the capsulorhexis tear to extend to the periphery on account of high intracapsular pressure. The anterior capsule may undergo disintegration with deposition of calcium or growth of focal plaques may hinder the capsulorhexis[6].

The use of Trypan blue facilitates CCC formation, provides a safe surgery, resulting in decrease in intraoperative complications. Nuclei of varying hardness may be masked by a totally opaque cortex. After the nucleus is removed by the divide and conquer or the phaco chop technique, a posterior chamber intraocular lens can be implanted. Even for an experienced surgeon harder nucleus will require a longer time and higher power of phacoemulsification. A plaque or residual posterior capsule is observed in spite of successful surgery[7].

This study was conducted in the department of ophthalmology, Holy family hospital, Rawalpindi. We evaluated the safety and postoperative visual outcome in patients undergoing phacoemulsification in white mature cataract.

MATERIAL AND METHODS

After approval from the local ethical committee, this cross sectional study was carried out between January 2017 and June 2017. In this study, 50 eyes of the 50 patients with white mature cataract were evaluated prospectively. All eyes in mature cataract group lacked red fundus reflex. Cataracts appearing white on slit lamp examination were defined as white mature, hypermature or brunescent cataracts. Patients with diabetes mellitus, glaucoma, pseudo exfoliation, complicated cataract, poor pupil dilation (< 5mm), history of ocular surgery, laser treatment or trauma were excluded. Written informed consent was obtained from each patient.

Preoperative ocular examinations included Snellen visual acuity, detailed biomicroscopic examination including anterior chamber examination, Goldmann Applanation tonometry, axial length and anterior chamber depth measurements with A-scan ultrasonography. Keratometry was performed using an Autokeratorefractometer.

Mydriacyl 1% and phenylephrine 2.5% eye drops were used for mydriasis, 1 hour before the surgery. Three surgeons performed all surgeries. Endocapsular phacoemulsification was performed in all cases by using infinity Alcon and Opticon phacoemulsification unit by one of the three surgeons in an identical manner. Topical or retrobulbar anaesthesia was used. Pieces of cotton sponge impregnated with proparacaine HCL 0.5% were placed deep into superior and inferior fornix, for 15 minutes before surgery for topical anaesthesia. Retro bulbar injection was performed using a 23-gauge needle, 3 ml of 2% lidocaine was given intraconallly.

Nuclear hardness was subjectively evaluated by the surgeon intraoperatively during phacoemulsification and was graded as soft, semi soft, medium, hard, very hard. Effective phaco time displayed by the phacoemulsification unit for each surgical procedure was recorded.

A three-step clear corneal tunnel incision was made with a 3.2 mm disposable metal blade and a side port incision was made with side port knife. Staining of the anterior capsule was done with trypan blue under air. After injection of dispersive viscoelastic sodium chondroitin sulfate-sodium hyaluronate into the anterior chamber of eyes, continuous curvilinear capsulorhexis was performed. Before completing the CCC liquefied milky cortex was aspirated in eyes to decrease high intracapsular pressure for the safety of capsulorhexis. Radial tears occurred in patients and conversion to extra capsular cataract extraction was preferred in these patients. After CCC hydro dissection was performed carefully in these cases because posterior capsule is thinner and more fragile in hard cataracts. Nucleus was removed by using divide and conquer or stop and chop to prevent damage to corneal endothelial cells as more energy is used in hard cataracts. Cortex was aspirated with

irrigation and aspiration and anterior chamber was filled with cohesive viscoelastic substance and foldable monofocal posterior chamber IOL was implanted in the capsular bag through an injector system. The viscoelastic material was aspirated completely, the entrances were closed with stromal hydration and for endophthalmitis prophylaxis sub-conjunctival antibiotic ceftriaxone and steroid dexamethasone injection was given.

Post-operative examinations were done at 1 day, 1 week, 1st and 3rd months. After surgery patient used topical antibiotics 2 hourly, steroid 4 hourly, daily for 1 week and topical steroid was tapered for subsequent 4 weeks. Patients who had transient or persistent corneal edema were managed with intense topical steroid and hyper-osmotic agents that took 6 weeks to resolve. Preoperative and postoperative BCVA values were used for statistical analyses. Preoperative and intraoperative findings as well as postoperative outcomes were analyzed.

SPSS version 21 was used for statistical analysis. Data was compared by using paired t test.P< 0.05 was accepted as significant.

RESULTS

Out of total 50 patients, there were 28 males (56%) and 22 females (44%).The mean age was 63.18 ± 7.997 years with a range of 48 to 78 years. Out of 50 patients, 22 (44%) patients had mature cataract, 15 (30%) patients had hyper-mature cataract, 13 (26%) patients had Brunescent cataract. Pre-operative best-corrected visual acuity (BCVA) was recorded which ranged from light perception (0.01) to 3/60 (0.05) (Table 1). Forty one patients had uneventful surgery with no intraoperative complications. Intraoperative complications included premature entry of the tunnel into the anterior chamber, incomplete capsulorhexis, and posterior capsular tear, conversion to a manual non-phacoemulsification technique, intraoperative miosis, and iris chafing. Intraoperatively Trypan blue staining was used in all patients. Aspiration of liquefied milky cortex was performed in patients before completing CCC. Radial tears occurred in 5 (10%), Posterior capsular rupture occurred in 3 (6%), vitreous loss occurred in 1 (2%) patient. 5 (10%) cases were converted to extra capsular cataract extraction (ECCE) with IOL implantation in the sulcus. No nucleus drop occurred.

Mean phacoemulsification time was 4.08±1.03 (SD) minutes with a range of 2.08-6.66 minutes (Figure 1). The mean preoperative intraocular pressure IOP was 15.90 ± 1.799 (SD) mmHg range (12-22) and mean post op IOP was 11.98 ± 2.035 (SD) mmHg range (10 – 18). The mean post operative IOP was significantly lower than that of preoperative value. Preoperatively Phacomorphic glaucoma was present in none patient and their IOP were significantly lower postoperatively without any medication.

Postoperatively 10 (20%) patients had transient corneal edema lasting one week which resolved with topical steroid therapy, 3 patients (6%) had persistent corneal edema and corneal burn treated with intense topical steroids and hyper osmotic agents, their corneal edema resolved within 6 weeks. Corneal burn occurred in two (4%) cases. Severe striate keratitis occurred in four (8%) patients. three (6%) patients had three plus cell count in anterior chamber, which resolved with intense topical steroids in 1 month. Postoperatively IOL dislocation occurred in one (2%) patients. Postoperative IOP rise occurred in none of the cases. These postoperative complications are summarized in table 2.

At 3rd post-operative month, BCVA ranged from

Table 1: Pre- operative best corrected visual acuity.

Grading of Visual Acuity (Snellen Decimal Fraction)	Frequency	Percent	Valid Percent	Cumulative Percent
Perception of light(0.01)	15	30.0	30.0	30.0
Hands Movement(0.02)	26	52.0	52.0	82.0
Counting finger up to 3 meters(0.03)	6	12.0	12.0	94.0
Counting finger better than 3 meters to 6/60(0.04-0.05)	3	6.0	6.0	100.0
Total	50	100.0	100.0	

Table 2: Postoperative complications.

Post-operative Complications	Frequency	Percent	Valid Percent	Cumulative Percent

No complication	29	58.0	58.0	58.0
Transient Corneal Edema	10	20.0	20.0	78.0
Persistent Corneal Edema	1	2.0	2.0	80.0
Corneal Burn	1	2.0	2.0	82.0
Striate Keratitis	4	8.0	8.0	90.0
Post-operative uveitis	3	6.0	6.0	96.0
Corneal burn plus striate keratitis	1	2.0	2.0	98.0
IOL dislocation plus persistent corneal edema	1	2.0	2.0	100.0
Total	50	100.0	100.0	

Table 3: Post-operative best corrected visual acuity.

Grading of Visual Acuity (Snellen Decimal Fraction)	Frequency	Percent	Valid Percent	Cumulative Percent
less than or equal to 6/60 (≤ 0.1)	2	4.0	4.0	4.0
6/36 to 6/18 (0.1-0.3)	10	20.0	20.0	24.0
6/12 to 6/6 (0.5-1.0)	38	76.0	76.0	100.0
Total	50	100.0	100.0	

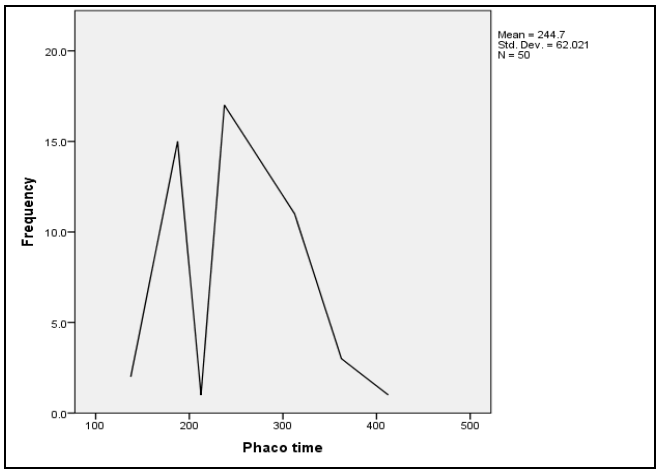

Fig. 1: Mean Phacoemulsification time

≤6/60 (≤ 0.1) to 6/6 (1.0) (Table 3). BCVA was significantly higher than mean preoperative BCVA. (P < 0.001).

DISCUSSION

Mature and hypermature cataracts constitute a significant volume of the cataract surgical load in ophthalmic practice in the developing countries. There were an estimated 1,140,000 (962,000-1,330,000) blind adults in Pakistan in 2003. Countryside areas had a higher frequency of blindness than did urban areas (3.8% vs. 2.5%). Most patients have advanced stages of cataract with intumescent, mature or hypermature cataract. Majority of these patients are less privileged[8].

White mature cataracts are a challenge for cataract surgeon and carry some difficulties. The most critical step of phacoemulsification surgery is Continuous Curvilinear Capsulorhexis. If it is not complete, some intraoperative complications such as posterior capsule rupture, vitreous loss and nucleus drop may occur. Because the red reflex is compromised in white cataract, it is difficult to complete CCC safely. Trypan blue provides a safe CCC[7,9].

General recommendations for visualization of anterior capsule in eyes with mature white cataract include dimming the operation room lights, increasing the magnification of microscope, using oblique illumination, capsule dyes. Giammaria D et al and Wong et al, stained the capsule under an air bubble, it was reported that using the dye under the dispersive viscoelastic material was easier and safe. The air bubble technique was reported to be time consuming[7,10]. The rate of conversion to ECCE in white cataracts as a result of an incomplete CCC has been as low as 3.85% when Trypan blue is used compared to 28.3% when no staining was used. In our study, we used Trypan blue in all patients, and radial tears occurred in five patients and rate of conversion to ECCE was 10%. It has been reported that Trypan blue did not cause any inflammation, corneal edema, corneal thickening, decrease in endothelial cell count and IOP rise[11]. Portes et al demonstrated that Trypan blue caused lens epithelial cell death, which supported the hypothesis that staining with Trypan blue 0.1% helps reducing the incidence of posterior capsule opacification after cataract surgery. The frequency of capsular rupture and vitreous loss can be reduced by staining the anterior capsule with the Trypan blue to identify the capsular tear at an early stage. We achieved a 5 mm capsulorhexis in most of the cases [12].

Kara junior et al recommended the mini rhexis technique for white intumescent cataracts in which

primarily a small CCC was performed then enlarged. Two stages CCC prevented unanticipated radial tears of the initial capsulotomy due to elevated intra capsular pressure[13]. We aspirated liquefied milky cortical matter via cannula in 15 patients before finishing CCC to avoid sudden radial tears due to highly intracapsular pressure. Chen and Wu suggested automated irrigation and aspiration by lowering of BSS bottle to aspirate the liquefied milky lens contents before phacomulsification[14]. Daglioglu et al suggested an innovative capsulorhexis technique in white cataract surgery in which CCC was completed by using an irrigation and aspiration system by phaco machine, it was found safe in white cataracts[15].

Although hydro dissection was not recommended in white mature cataracts, we observed that gentle hydro dissection broke the cortico-capsular adhesions that could resist free nucleus rotation[1]. Singh et al reported cortico-capsular adhesions resulted in different nucleus rotation in brunescent and black cataracts. Nucleus rotation is critical for phacoemulsification[16].

Posterior capsule is not only weak but also flaccid with wrinkles and laxity that makes it prone to be ruptured. The problem is worsened by absence of any epinucleus that protects the posterior capsule. A useful step is to inject a dispersive non–cohesive viscoelastic behind the nucleus during the phacoemulsification, which will provide an artificial epinucleus to keep the posterior capsule back from the operating plane and stabilize the nucleus against tumbling[17].

In Brunescent and black cataracts, the lens fibers were found to be very cohesive thus making division difficult. White cataracts in our study were usually brittle and not very hard; they were safely divided and emulsified. During the division and aspiration of the nucleus, edge of the hard nucleus may cut the posterior capsule, resulting in rupture; also radial tears in anterior capsulotomy may extend to posterior capsule and cause rupture. Therefore, the incidence of posterior capsule rupture is higher in mature cataracts[18]. In our study rate of posterior capsular rupture was 6%.

Phacoemulsification of hard nucleus requires higher ultrasonic energy, which is partially converted to heat energy causing corneal endothelial damage and corneal burns. Fluid dynamics during phacoemulsification may cause endothelial cell damage if it lasts longer[18]. With aging, endothelial cell count decreases, this is another risk for patients with mature cataracts; therefore, chances of post-operative corneal edema is higher in patients with mature cataract[18,19].

In our study, we did not encounter complications of capsular fibrosis and geometrical decentration. In another study, capsular fibrosis was reported to occur in 12% of eyes with white mature cataracts all of which had a capsulorhexis diameter of less than 5 mm[20]. Small capsulorhexis leads to capsule contraction.

Yuan et al recommended that ophthalmic viscosurgical device assisted sutureless cataract surgery, usually without additional instruments, or sutures presented an efficient and uncomplicated technique for managing a brunescent or mature cataract[21]. Venkatesh et al compared manual small incision cataract surgery with phacoemulsification for white cataract and reported that both techniques achieved excellent visual outcomes with low complication rates[22]. Wong et al suggested that micro-incisional cataract surgery with bimanual phacoemulsification appeared to be a hopeful alternative for management of white cataracts[23]. Kim and Jang proposed drill and chop technique for hard cataracts, which required complete engagement of central nucleus by phaco tip. First, a hole was drilled into the endonucleus by rotating the Kelman phaco tip clockwise, nucleus was deeply impaled horizontally and completely engaged by phaco tip followed by vertical chopping and it resulted safer and more effective vertical chopping in patients with harder cataracts[24]. Li et al described the peripheral radial chop technique in phacoemulsification of harder nuclei and stated that it was effective without grave complications in hands of skilled surgeons[25].

The limitation of our study was that it was performed in one center. More studies need to be performed with larger number of patients in multiple centers.

CONCLUSION

White mature cataract is a challenge for phaco surgeons but with appropriate techniques such as two stage capsulorhexis and use of additional capsule staining dyes can achieve excellent visual outcomes and low complication rates.

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