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Phacoemulsification in White Cataract: Demographic Profile, Associated Difficulties and Visual Outcomes

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Abstract:-
Aim: To evaluate the demographic profiles of the patients, associated problems and visual outcomes of phacoemulsification in eyes with white cataract.

Design: A prospective interventional study.

Materials & Methods: A prospective interventional study of 76 patients done who had either mature or hyper-mature cataract and underwent phacoemulsification surgery. All pre- and postoperative data were recorded according to the protocol of cataract clinic of the hospital. All surgeries were done under peri-bulbar anesthesia and by single surgeon. In all cases two plane clear corneal incision of 3.2 mm, continuous curvilinear capsulorrhexis (CCC), phacoemulsification by stop and chop and in bag IOL implantation done. CCC was done by two step procedure to reduces the intra-lenticular pressure and prevent 'Argentina flag sign'. All patients were followed up at 1st postoperative day, 7th postoperative day, one month and 3 months.

Results: Mean ages was 55.28±9.72 years (ranged 32 to 75 years) and 41% belonged to 51-60 years. Among different occupations, a significant number of patients (43.42%) were housewives and 64.47% patients were from rural areas. About 67% patients had different systemic diseases (diabetes, hypertension, ischemic heart disease, asthma etc.). Mature cataract was 60% and remaining was hyper-mature cataract. Mean phaco-time was 0.27±0.11 minutes. Superior clear corneal incision didn't cause statistically astigmatic change postoperatively. The final best corrected acuity in good category (6/6 to 6/18) achieved in 98.70%. Ninety two percent patients showed no associated complications.

Conclusion: By making good capsulorrhexis with the use of trypan blue and two step procedure that is initial small 'can opener capsulotomy' which reduces the intra-lenticular pressure followed by an appropriate capsulorrhexis make the surgery safer and good visual outcome.

Keywords:- *Phacoemulsification, White Mature Cataract, Hyper-Mature Cataract, With The Rule Astigmatism, Against The Rule Astigmatism, Intraocular Lenses, Continuous Curvilinear Capsulorrhexis.*

I. INTRODUCTION

Cataract is the most common reversible blindness in the world. White cataract or senile mature cataract is an advanced form of cataract disease.[1] A cataract is termed white and mature if the cortex and nucleus become so opaque that the red fundus reflex is absent and the cortex becomes extensively hydrated. In developing countries White mature cataracts are very common scenario in developing countries.[2,3] White cataracts may be divided into three types: 1) cortically mature cataract with diffusely flocculent cortex and may be associated with raised intra-lenticular pressure (intumescent, swollen cataract); 2) mature cortical cataract with flocculent cortex and a hard, brown nucleus; and 3) gelatinous cortex and soft nucleus with uniformly soft cataract.[1] Phacoemulsification of white mature cataract with posterior chamber intraocular lens implantation may associated with higher rate of complications such as difficulty in capsulorrhexis due to fragile capsule, obscure visualization due to leakage of liquefied cortical material and absence of red reflex , and tendency of peripheral capsulorrhexis tear tear because of high intra-capsular pressure. [2,3] The anterior capsule may undergo degeneration with deposition of calcium or development of focal plaques which may interfere with the capsulorrhexis. Due to hardness of nucleus, it usually require a longer time and higher power for phacoemulsification even in expert surgeons. A plaque or residual posterior capsule opacification is observed despite of successful surgery. Thus, surgical removal of white mature cataracts presents special challenges to the surgeon.[2,3] In the present study, we were trying to find out the demographic profiles of the patients, associated surgical difficulties, complications and visual outcome of phacoemulsification in white mature cataract.

II. MATERIAL AND METHODS

This interventional prospective study was done at Chittagong Eye Infirmary and Training Complex one of tertiary eye care hospital of Bangladesh, from 01.01.2019 to 31.12.2019. Total 76 cases were selected for surgery and all surgeries were done by single qualified phaco- surgeon. Inclusion criteria were senile age related white cataract lack of red fundus reflex including mature (including intumescent) and hyper mature (including morgagnian and sclerotic) cataract. Complicated cataract, traumatic cataract, secondary cataract, pseudoexfoliation syndrome, subluxated lens, cataract with corneal opacities, abnormal pupil, posterior segment disease like vitreous opacity, high myopia or any other retinopathy and glaucoma causing functional impairment of vision were excluded from this study. B-scan ultrasonography was done in all patients to see position of retina and vitreous. Related all pre- and postoperative data were recorded according to the protocol of the hospital. SRK-T formula was used for intraocular lens power calculation. The study was approved by local IRB and done and conducted according to the principles of the 2013 revision of the Declaration of Helsinki.

➢ *Surgical procedure*

Tropicamide 0.8% and phenylephrine hydrochloride 5% ophthalmic topical drops were used for mydriasis. All surgeries were done under peri-bulbar anesthesia. Two step clear corneal tunnel incision was made at superior cornea near limbus with 3.20 mm keratome and a side port incision at 2.00 O'clock position was made with a 15° knife. Anterior capsule was stained with 0.1% trypan blue. Two percent hydroxypropyle methylcellulose is introduced into anterior chamber. Two step anterior capsulotomy was done to avoid peripheral extension or to prevent 'Argentina flag sign'. First a small 'can opener' capsulotomy with multiple strokes with capsulotomy needle was made with a 27 gauge needle. Liquid cortical material was aspirated with Simcoe cannula. Approximately 5 mm continuous curvilinear capsulorrhexis was performed by grasping the capsular tag with capsulorrhexis forceps and tear the capsule in the curvilinear manner. Fibrosed and calcified areas of capsule was cut by Venus scissor. Gentle hydro-dissection was made in intumescent mature cataract and the nucleus was rotated with anterior chamber cannula. Hydro-dissection was avoided in morgagnian and sclerotic cataract. Phacoemulsification of the nucleus was performed using the stop-and-chop or direct chop technique at iris plane. Maximum torsional power was set to 100%, vacuum 400 mm H_2O, and inflow 40 mL/min. Cortical remnants were removed by two way Simcoe cannula. In bag IOL implantation done in every cases. Half cc. subconjunctival injection of dexamethasone (5mg/ml) and gentamicin (40mg/ml) was given to all patient at superior conjunctiva.

Post operatively patients were treated with topical corticosteroid six times daily approximately four weeks then tapered, topical antibiotic four times daily for one week and topical cycloplegic once daily for two weeks. Doses and duration of topical corticosteroid was increased according to postoperative inflammation. All patients were followed up at 1st postoperative day, 7th postoperative day, one month and 3 months.

Visual acuity was assessed using Snellen's charts in each follow up. Refraction (BCVA) and keratometry was done at final follow-up to detect post-operative astigmatism. Visual outcome (best corrected visual acuity-BCVA) was categorized according the World Health Organization [4] (W.H.O) standard where good vision is 6/6 to 6/18, borderline vision is less than 6/18 to 6/60 and poor vision is less than 6/60. Post-operative astigmatism was expressed as the power of the cylinder lens needed for best correction. All cylindrical lens power pre-and postoperatively was converted into minus and categorized as "acceptable astigmatism (mild)" (0 to ≤ 0.50 DCyl) as this range would not hamper the patient's vision, "moderate astigmatism" (> 0.50 to ≤ 1.50 DCyl) and "large astigmatism" (>1.50 DCyl). [5] Internationally accepted post-operative corneal astigmatism is 0.50D [5,6]. Statistical analysis relevant data were done by using SPSS16 software. A *'p'* value <0.05 was considered significant.

III. RESULTS

Mean ages was 55.28±9.72 years (ranged 32 to 75 years) and most of the patients belonged to 51-60 years [figure 01]. Slightly male predominance 52.63% (n-40). Among different occupations, a large percentage (43.42%) were housewives [figure 02]. Most patients (64.47%) patients came from rural areas and eighty six percent was from average socio economic condition.

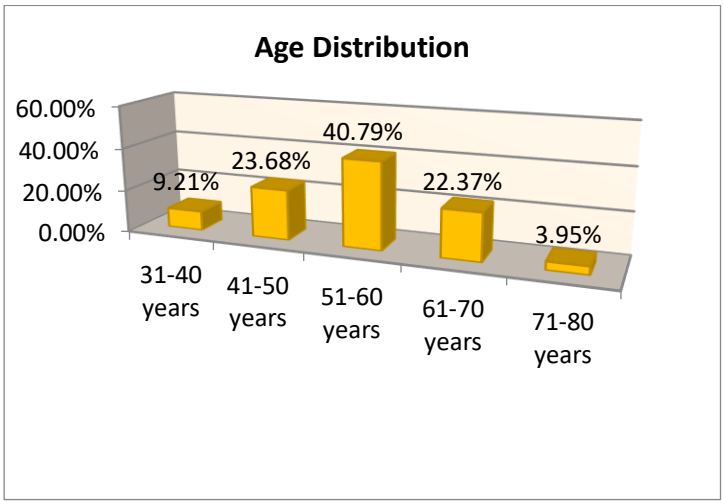

Fig 1: Age distribution of patients.

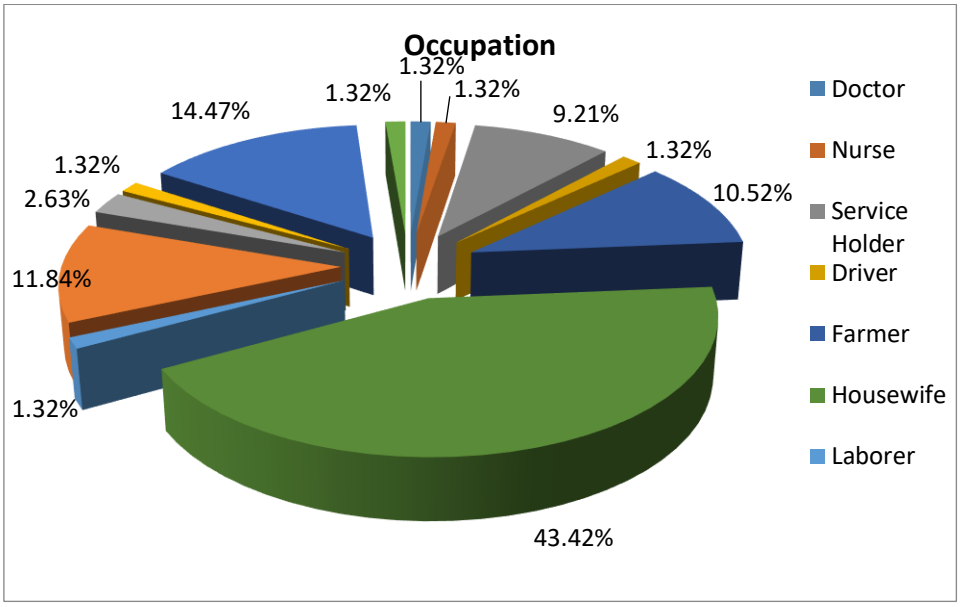

Fig 2: Distribution of occupation.

Different systemic diseases was associated in 67% (n-51) patients and hypertension was most common (47%, n-36). Both hypertension and diabetes was present in 26% (n-20).

Preoperative vision was finger counting in 60% patients (n-46), followed by hand movement 25% (n-19 [table 01]. About sixty eight percent patients (n-52) presented with mature cataract and remain 31.58% (n-27) were hyper-mature. Out of hyper-mature cataract 22.37% (n-17) were morgagnian type and 9.21% (n-7) were sclerotic.

Table 1: Preoperatively visual acuity.

Pre-operative VA	Frequency	Percent
FC	46	60.50%
HM	11	14.50%
PL	19	25%
Total	76	100%

Foot note: VA= Visual acuity, FC= Finger counting; HM= Hand Movement; PL= Perception of Light

Mean IOL power 21.57±1.70 diopter (range 18-25.5 diopter) and about 83% (n-63) patients have had their IOL power range (20-24) diopter. Mean phaco-time was 0.27±0.11 minutes (range 0.08-0.48 min).

In the study group preoperative 'with the rule astigmatism' (WTR) was 47.36% (n-36), 'against the rule astigmatism' (ATR) was 50% (n-38) and 'no astigmatism' (NO) was 2.64% (n-02), whereas postoperatively 'with the rule astigmatism' reduced to 36.84% (n-28), 'against the rule astigmatism' became increased to 61.84% (n-47) that was increased and 'no astigmatism' reduced to 1.32% (n-1). Among WTR astigmatism group (47.36%), 30.26% remains at the same group and about 17.11% (n-13) turn to ATR astigmatism after surgery. Among 50% (n-38) cases of pre-operative ATR astigmatism, post-operatively more than 43.42% (n-33) was remain at the same group. About 2.64 (n-2) % cases was present preoperatively at the group of "no astigmatism", one of them (1.32%) remain in "no astigmatism" and one of them (1.32%) changed into ATR astigmatism group post-operatively [table 03]. The changes among the pre- and post-operative rule astigmatism statistically are very negligible ($p < 0.05$).

In comparison between the mild/acceptable, moderate and large groups of astigmatism there is no statistically significant change observed between the pre-operative and post-operative status of the cases ($p<0.05$). In the group of "Acceptable" astigmatism the pre-operative cases were 52.63% where as in the post-operative cases percentage was same. In "Moderate" group, the number decrease from 44.74% to 40.79% and the increasing tendency was for the "Large" group where post-operative cases were increased from 2.63% to 6.58%. [Table 02].

Table 2: Comparison of pre- and post-operative astigmatic change.

Astigmatism (Diopter)	Preoperative		Postoperative		*'p'* value
	N	%	N	%	
0 to ≤ 0.50: Mild/Acceptable	40	52.63%	40	52.63%	0.00
> 0.50 to ≤ 1.50: Moderate	34	44.74%	31	40.79%	
> 150: Large	02	2.63%	5	6.58%	
TOTAL	100	100%	100	100%	
(x2=42.18; Cramer's V= 0.430; df=9; p= 0.00 (p< 0.05)					

Table 3: Postoperative visual acuity

VA	1st day (unaided)	3 month (unaided)	3 month (BCVS)	WHO standard
6/6 to 6/18 (Good)	94.70%	93.40%	98.70%	>80%
6/24 to 6/60 (Borderline)	5.30%	6.60%	1.30%	<15%
< 6/60 (Poor)	00.00%	00.00%	00.00%	<5%
TOTAL	100%	100%	100%	100%

Foot note: VA- Visual acuity, BCVS-Best corrected visual acuity.

It was observed, in first post -operative day unaided visual acuity was good in 94.70% patients and it was dropped to 93.40% after 3 months follow up. The final best corrected acuity in good category achieved in 98.70% (*p=0.000. <0.05*). [table 03].

Majority of patients (63.12%, n-48) achieved postoperative final refraction of <-1.00 to -0.12 diopter spherical equivalent. Emmetropia was achieved in 26.32% (n-20) patients [figure 09].

About 92% (n-70) patients showed no associated complications, capsulorrhexis extended in 2.63% (n-2) patients and there were trace posterior capsular opacification in about 4% (n-3) patients. In one patient, one haptic of intraocular lens was broken during implantation which was replaced at the same time of surgery [figure 10]. Postoperatively no patients developed secondary glaucoma.

IV. DISCUSSION

Phacoemulsification of white cataracts is associated with some difficulties and a higher rate of intraoperative complications. White mature cataract is so opaque that the red fundus reflex is absent. To perform successful continuous curvilinear capsulorrhexis, the surgeon can use different dyes for staining the anterior capsule for contrast enhancement. Anterior capsular staining can be performed with 0.1% trypan blue, 0.5% indocyanine green (ICG), 0.05% gentian violet, 2% fluorescein sodium and autologous blood. Several studies showed the use of these dyes to be safe and effective, and trypan blue, ICG and gentian violet are more effective in staining the capsule.[6,7,8,9] In our all cases we used 0.1% trypan blue to stain anterior capsule. Making a continuous curvilinear capsulorrhexis in white cataracts is more challenging due to fragile, calcified and fibrosed capsule, leakage of the liquefied cortical material which obscure visualization and high intralenticular pressure which leads to capsulorrhexis tear to the periphery. Here we used a different technique for doing capsulorrhexis to avoid peripheral extension or to prevent 'Argentina flag sign'. First a small CCC or small can-opener capsulotomy with multiple strokes with capsulotomy needle was made with a 27 gauge needle. Liquid cortical material was aspirate with Simcoe cannula to reduce the intralenticular pressure. Approximately 5 mm continuous curvilinear capsulorrhexis was performed by grasping the capsular tag with capsulorrhexis forcep and tear the capsule in the curvilinear manner. Fibrosed and calcium deposited areas of capsule was cut by Venus scissor. Hydrodissection was avoided in morgagnian and sclerotic cataract and gently done in mature white cataract. Gentle hydrodissection in different quadrant and slight repeatedly tapping pressure over the nucleus facilitates nuclear separation and rotation, although hydrodissection is not so important in cases of white cataracts.[2] Phacoemulsification of the nucleus was performed using the stop-and-chop technique at iris plane.[11] Maximum torsional power was set to 100%, vacuum 400 mm H_2O, and inflow 40 mL/min. In our cases 91% nucleus were grade-2, small and fragile, 9% were grade-3 nucleus. Hard nucleus needed increased phacoemulsification energy which may causes corneal endothelial loss leading to corneal edema. Here we used 100 torsional phaco power but did not use any longitudinal phaco power. Our mean phaco time was 0.27±0.11 minutes (0.08 to 0.48 min). None of our case developed postoperative corneal edema.

One study showed that incision through either temporal clear cornea or superior scleral tunnel in phacoemulcification has no statistic difference in astigmatism change on keratometry at 3-month postop.[12] Other study showed temporal clear corneal incision is evidently better than superior clear corneal incision as far as surgically induced astigmatism is concerned.[13] In our study it is observed that clear corneal incision at superior limbus showed no statistically significant change in surgically induced astigmatism postoperatively *(p=0.00, <0.05)*. Apart from surgically induced astigmatism it was observed, first postoperative unaided visual acuity was good in 94.70% patients and it was dropped to 93.40% after 3 months follow up but the final best corrected acuity in good category was 98.70% *(p=0.000,<0.05)*. Presence of hard nucleus where lens fibers are very cohesive thus making division difficult [14], thin posterior capsule and stretched by expanded intumescent lens and also flaccid with wrinkles and a laxity that makes it prone to be ruptured during phacoemulsification particularly during nuclear fragment consumption stage. The problem is worsened by the absence of any epinucleus that protects the posterior capsule. White cataracts in our study were usually brittle and not very hard. 90% were grade-2 and they were safely divided and emulsified and 09% were grade-3 where leathery fibers kept most of the nucleus joined. However, no patients were complicated with posterior capsular rupture as well as nuclear drop.

Small capsulorrhexis was reported to lead to capsule contraction. [15,16] Capsular fibrosis was reported to occur in 12% of eyes with white mature cataracts, all of which had a capsulorrhexis diameter of less than 5 mm.[3,16] In our study we did not found any capsular fibrosis within 3 months follow up period. Our all capsulorrhexis size was 5.5-6 mm. In our study, intraoperatively posterior capsular plaque or opacity

was found in 3.95% of the patients. Studies reported this ratio as 27.3% and 33%. [3, 17] This difference may be related to the prolonged waited time for the surgery. In developing countries white mature cataracts may constitute a significant proportion of the patients with cataract. [18] Here we observed 43.42% of our patients were housewives and this large portion may have lack of awareness or may have less care in their family. Most of the patients (64.47%) came from rural areas and 86.84% have average socioeconomic condition may have lack of awareness.

V. CONCLUSION

Although intraoperative complications of phacoemulsification of white mature cataract is high, a successful continuous curvilinear capsulorrhexis can be done with use of trypan blue and two step procedure that is initial small canopener capsulotomy which reduces the intralenticular pressure followed by an appropriate capsulorrhexis make the surgery safer and good visual outcome.

LIMITATIONS

1. No pre- and postoperative study of corneal endothelium.
2. Not measured anterior chamber depth change.
3. Not measured the central corneal thickness changes.

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