Original Research Article

A clinical study of intra-operative complications of Phacoemulsification and their management

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Abstract

Background: Cataract is the leading cause of preventable blindness in the world, whereas cataract extraction with intraocular lens (IOL) implantation is perhaps the most effective surgical procedure in all of medicine. Smaller incision sizes achievable with techniques of Phacoemulsification with insertion of foldable intra ocular lenses or small phaco profile lenses have made postoperative recovery quicker with faster optical and physical rehabilitation of the patient.

Aim: Present study was done to know the nature of intra-operative complications in patients undergoing Phacoemulsification and to identify the factors responsible for intra-operative complications during Phacoemulsification and to study the management of the same.

Materials and methods: The study was conducted for a period of 1 year. It was prospective study comprised 100 patients who underwent Phacoemulsification. The patients were selected by simple random sampling and were followed up for a period of 6 weeks.

Results: Majority of the patients were in the 51 to 60 years age group, females constituted the majority, being 57 in number (57.0%) as compared to males (43.0%). Posterior subcapsular cataract was the most common type of cataract in the present study and was seen in 36 eyes (36%). Pre-operative best corrected visual acuity ranged from 6\12 to counting fingers at one meter. 71.0% patients had pre operative best corrected visual acuity of 6/36 or better. Total Phacoemulsification time lasted less than one minute in 33% patients. In majority of the patients (63%), phaco time lasted between one to two minutes. Intra-operative complications occurred in 17.0% of the 100 cases included in the study. The most common complication encountered was difficulty in emulsifying an unexpectedly hard nucleus with conversion to small incision cataract surgery in 4 cases (4%). Incidence of complications seems to increase with increase in grade of the nuclear cataract. Post-operative best

corrected visual acuity after 6 weeks of follow up was found to be 6/9 or better in 83% of cases and was 6/12 or better in 96% of cases.

Conclusion: Good visual outcome obtained with Phacoemulsification and better management facilities available, shows this can be accepted and practiced as a routine for good visual outcome in cataract patients.

Key words

Phacoemulsification, Posterior subcapsular cataract, Best corrected visual acuity.

Introduction

The lens is far from being just a "bag of proteins". It is a highly ordered structure with a close orderly packing of lens fiber cells [1] and is an important contributor to the refractive power of the eye. Any opacity in the lens or its capsule, whether developmental or acquired, is called a cataract. Cataract is the leading cause of preventable blindness in the world, whereas cataract extraction with intraocular lens (IOL) implantation is perhaps the most effective surgical procedure in all of medicine [2].

A technologic explosion has arisen in the techniques of cataract extraction over the past few decades. Advances in operative equipment and micro surgical instruments have made cataract surgery very safe and effective in restoring vision.

Smaller incision sizes achievable with techniques of Phacoemulsification with insertion of foldable intra ocular lenses or small phaco profile lenses have made postoperative recovery quicker with faster optical and physical rehabilitation of the patient. Although the surgery is now safe and successful in the large majority of patients, it is not without inherent problems and potential complications.

Present study was done to know the nature of intra-operative complications in patients undergoing Phacoemulsification and to identify the factors responsible for intra-operative complications during Phacoemulsification and to study the management of the same.

Material and methods

It was an attempt to assess the nature of intra-operative complications and their management in patients undergoing Phacoemulsification. The study was conducted at the Department of Ophthalmology, Regional Eye Hospital. The study period was from February 2014 to September 2015. This prospective study comprised 100 patients who underwent Phacoemulsification. The patients were selected by simple random sampling and were followed up for a period of 6 weeks.

Inclusion criteria

- Patients undergoing Phacoemulsification at Regional Eye Hospital, Warangal with immature senile cortical cataract, nuclear cataract of grade III and below.
- Patients above 18 years of age; irrespective of sex.

Exclusion criteria

- Any patient with subluxated lens.
- Patients with nuclear cataract of grade IV and above.
- Patients with hyper mature cataract.
- Patients with associated uveitis, glaucoma, traumatic cataract or any other ocular abnormality.

Cases were collected using a piloted proforma after informed consent. A thorough pre-operative evaluation was done. The best corrected visual acuity was determined on Snellen's chart. Slit lamp biomicroscopy was performed to evaluate type of cataract. Nucleus grading was done using Lens Opacity Classification system (LOCS) III. Applanation tonometry and evaluation of the patency of lacrimal passages was done. The readiness with which the pupil dilated was

assessed. Fundus examination was done after dilatation with indirect ophthalmoscopy, 78D lens. A detailed physical examination including assessment of blood pressure and glycemic status was done.

Preoperative biometry was done Ascan and posterior segment by Bscan. On the day preceding the surgery, the patient was advised to instill antibiotic drops. On the day of surgery, the eye to be operated upon was dilated with eye drops containing tropicamide (0.8%) and phenylephrine (5%), one drop every 10-15 minutes starting one hour before surgery till full dilatation. One drop of Flurbiprofen (0.03%) was also instilled after full dilatation to prevent intraoperative miosis.

All surgeries were done under peribulbar anaesthesia. 2% Lignocaine was used as the local anaesthetic in combination with adrenaline 1:1000 along with Hyaluronidase to facilitate diffusion of the anaesthetic solution. About 5 ml of local anesthetic was injected. Digital massage was given.

After taking all aseptic precautions eye lids were draped, wire speculum was placed; superior rectus bridle suture was passed and clamped on to the towel. Surgeries were done under operating microscopes 'OPMI® 1 FR pro' (Carl Zeiss, Meditec Inc.) and 'OM-10 Zoom' (Takagi Seiko).

Procedure of Phacoemulsification

After a good peribulbar block, a fornix based conjunctival flap was made. Episcleral and superficial scleral vessels were cauterised. 3 mm wide scleral incision was made with no. 15 blade to a depth of about one half of scleral thickness about 2 mm from the limbus. Superior or superotemporalsclerocorneal tunnel was made using a crescent blade. Entry into AC was made using a 3.2 mm Keratome blade. Side port incision was made in clear cornea at 9 O'clock position using a lancetip blade. Capsulorrhexis was performed using a bent 26G needle. In patients with poor red fundal reflex, trypan blue enhanced capsulorrhexis was done. The rhexis was approximately 5.5 to 6mm in diameter.

After hydrodissection and hydrodelineation rotation of the nucleus within the bag was confirmed. The second side port incision was then made using a lancetipblade at 2 O'clock position.

AMO SOVEREIGN compact phaco emulsification machine Aspirator was used for phacoemulsification. This machine has a peristaltic type of pump.

The technique of phacoemulsification used was usually the divide and conquer technique. A central trench was made in the nucleus. The settings used for creating the trench were approximately

Vacuum : 10-15 mm of Hg
AFR : 12-15 cc/min
Power : 70%

Once the first trench was made, the nucleus was rotated and a second trench was made perpendicular to the first. A central fracture was made by using a bimanual direct fracturing technique; in which the phaco probe was moved to one side of the bridge and the chopper was moved to the other. The nucleus was rotated to repeat the manoeuver in the second groove. While stabilizing one of quadrants with the chopper, the phaco tip was used to impale and emulsify it. The procedure was repeated until all quadrants were emulsified. The machine settings used for quadrant removal were approximately

Vacuum : 200-220 mmHg
AFR : 25-30 cc/min
Power : 50-60%

The settings were changed as per requirement and the hardness of the nucleus.

Total Phacoemulsification time was recorded as the machine used does not display effective phaco time. After Phacoemulsification of nucleus, removal of cortical material was done using bi-manual irrigation and aspiration cannula.

Either a foldable IOL or a rigid PMMA of 6 mm optic size PCIOL was inserted after extending the incision using a 5.1 mm keratome. Any intra operative complications that may have occurred during the procedure were noted.

At the end of the procedure the anterior chamber was formed using ringer lactate and both the side ports were hydrated. Sub-conjunctival injection of gentamicin and dexamethasone was given and the eye was bandaged. Post-operative instillation of topical antibiotic steroid combination (prednisolone acetate 1% along with moxifloxacin 0.5%) was advised. Patients were examined on first postoperative day and discharged. They were advised regular follow-up at 1st week, 3rd week and 6th week following surgery. All data was recorded in the proforma.

Results

Out of 100 cases, patients in the 51 to 60 years age group were maximum accounting for 30 cases followed by patients in the 61 to 70 years group with 26cases. 10 patients were above 70 years. Mean age was 57.73 years (**Table – 1**).

Table - 1: Demographic distribution in the study.

Age in years	**No. of patients**	**%**
21-30	2	2
31-40	8	8
41-50	22	22
51-60	30	30
61-70	26	26
71-80	10	10
>80	2	2
Total	100	100
Gender		
Males	43	43
Females	57	57
Total	100	100

Out of the 100 cases operated, posterior subcapsular cataract was most common and was seen in 36 patients (**Table – 2**). Pre and Post-operative best corrected visual acuity was as per **Table – 3**. Majority of the patients (63%), phaco time lasted between one to two minutes.

Table - 2: Details of cataract in study.

Eye involved	**No. of patients**	**%**
Right eye	45	45
Left eye	55	55
Type of cataract		
PSC	36	36
NC2	7	7
NC2+PSC	27	27
NC3	12	12
NC3+PSC	12	12
Cupiliform cataract	3	3
NC1+PSC	1	1
PSC+Cuneiform	1	1
Anterior capsular cataract	1	1

(PSC – Posterior subcapsular cataract, NC – Nuclear cataract)

Table - 3: Pre and Post-operative best corrected visual acuity.

Pre op BCVA	**No. of patients**	**%**
6/12 – 6/18	16	16
6/24 – 6/36	55	55
6/60 – CF5m	22	22
CF4m – CF3m	3	3
CF2m – CF1m	4	4
Post-operative BCV		
6/6 – 6/9	83	83
6/12 – 6/18	13	13
6/24 – 6/36	3	3
6/60 – 1/60	1	1

Out of the 100 eyes operated, intra-operative complications were seen in 17 cases. The most common complication was difficulty in emulsifying an unexpectedly hard nucleus with conversion to small incision cataract surgery in 4 cases (4%). PCR with vitreous loss was noted in 3 (3.0%) cases (**Table – 4**).

Incidence of complications associated with NC3, NC3+PSC was as per **Table - 5** with $p < 0.001$.

Relationship of post-operative BCVA to intra operative complications was as per **Table – 6**. Phaco time above 2.0 minutes was significantly associated with complications as per **Figure – 1**.

Table - 4: Intra-operative complications (N=100).

Intra-operative complications	No. of patients	%
Absent	83	83
Present	17	17
Nucleus could not be emulsified in to (converted to SICS)	4	4
PCR	3	3
Iris incarceration into phacoprobe	3	3
Running rhexis/ Incomplete CCC	2	2
Tunnel related/ premature entry	2	2
Surge	1	1
DM detachment	1	1
Iris prolapsed into sideport	1	1

Discussion

Hundred cases that underwent Phacoemulsification at Regional Eye Hospital were studied for intra-operative complications and management of these complications. The patients were examined on the immediate postoperative day, at the end of 1st week, 3rd week, and 6th week.

Out of 100 cases, majority of the patients were in the 51 to 60 years age group, accounting for 30% cases followed by patients in the 61 to 70 years group with 26%. Ten patients were above 70 years. Mean age was 57.73 years. Females constituted the majority, being (57.0%) as compared to males (43.0%) in the present study.

Out of the 100 eyes that were operated upon, 55 were left and 45 were right. Posterior subcapsular cataract was the most common type of cataract in the present study and was seen in 36%. The next most common type of cataract was a combination of grade 2 nuclear cataract with posterior subcapsular cataract (27.0%). The least common types of cataract were PSC with cuneiform cataract and anterior capsular cataract.

Pre-operative best corrected visual acuity ranged from 6\12 to counting fingers at one meter. 71.0% patients had best corrected visual acuity of 6/36 or better. Total Phacoemulsification time lasted less than one minute in (33%) patients and more than two minutes in (4%) patients. In majority of the patients (63%), phaco time lasted between one to two minutes.

Intra-operative complications occurred in 17.0% of the 100 cases included in the study. This is in concordance with the study conducted by Eiichi N, et al. [3]. The complication rate in their study was approximately 19.3%. Independent studies by Maj Mathur V, et al. [4] and Robin AL, et al. [6] showed a slightly higher incidence rate. The incidence rate in the present study was higher than that noted by Ng DT, et al. [5], however, it was in the mid range when all the above mentioned studies were taken into consideration (**Table – 7**). The most common complication encountered was difficulty in emulsifying an unexpectedly hard nucleus with conversion to small incision cataract surgery in 4% cases. PCR with vitreous loss was noted in 3.0% cases. Iris incarceration in the phaco probe was noted in 1% cases. Tunnel related complications were seen in 2% cases. Capsulorrhexis related complications were seen in 2.0% cases (**Figure – 2**).

Surge occurred in one (1%) case. Detachment of Descemet's membrane was noted in one (1%) case and prolapse of the iris through the side port was noted in another (1%).

As mentioned earlier, the most common complication noted was difficulty in emulsifying the nucleus in 4%. All these cases were converted to small incision cataract surgery. A similar situation was reported by Thomas R, et al. [7]. A similar approach was followed by the

authors in the above mentioned study with conversion to the Blumenthal manual small incision technique.

Table - 5: Association of intra-operative complications with cataract.

Type of cataract	No. of cases	Total complications	1	2	3	4	5	6	7	8
PSC	36	2 (11.8%)	0	1	0	1	0	0	0	0
NC2	7	1 (5.9%)	0	0	1	0	0	0	0	0
NC2+PSC	27	3 (17.6%)	0	0	1	0	1	0	1	0
NC3	12	4 (23.5%)	2	1	0	0	1	0	0	0
NC3+PSC	12	6 (35.3%)	2	1	1	0	0	1	0	1
Cuneiform	3	1 (5.9%)	0	0	0	1	0	0	0	0
Other	3	0	0	0	0	0	0	0	0	0
Total	100	17 (100%)	4	3	3	2	2	1	1	1

Table - 6: Relationship of post-operative BCVA to intra operative complications.

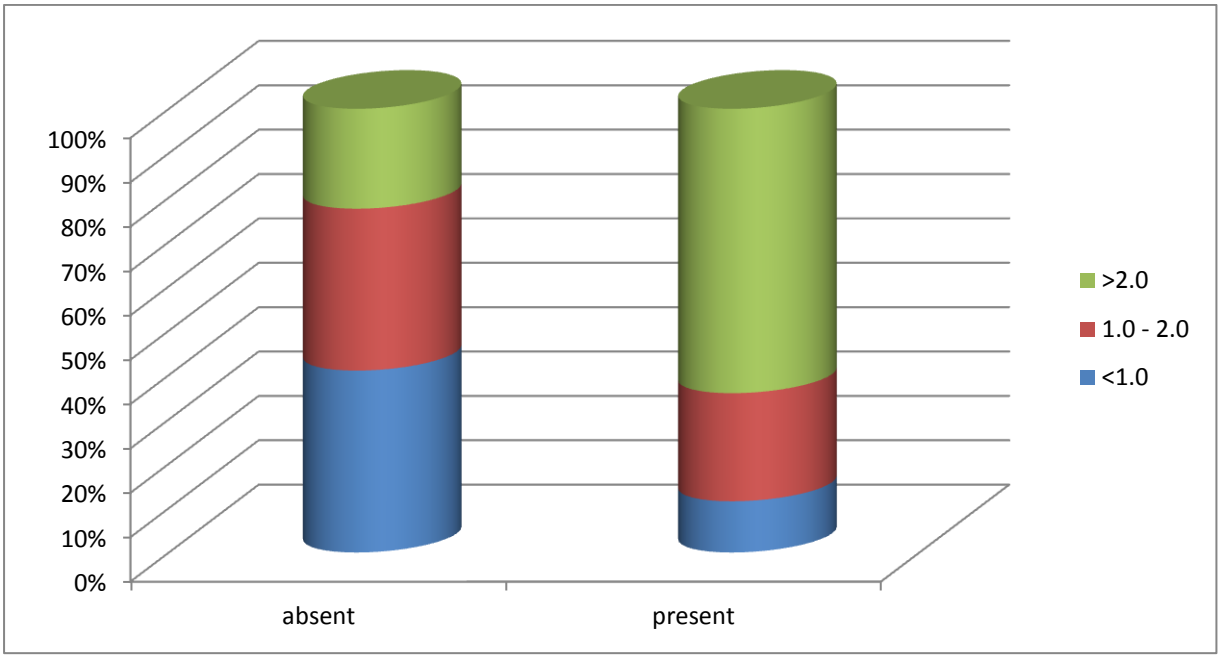
Inta-operative complications	No. of patients (N =100)	6/6-6/9 N=83	6/12-6/18 N=13	6/24-6/36 N=3	6/60-1/60 N=1
Absent	83 (83%)	76 (91.57%)	7 (53.84%)	0 (0%)	0 (0%)
Present	17 (17%)	7 (8.43%)	6 (46.16%)	3 (100%)	1 (100%)
Hardnucleus converted to sics	4 (4%)	2 (2.40%)	2 (15.38%)	0 (0%)	0 (0%)
PCR	3 (3%)	1 (1.20%)	1 (7.69%)	0 (0%)	1 (100%)
Iris incarceration in Phaco probe	3 (3%)	2 (2.40%)	1 (7.69%)	0 (0%)	0 (0%)
Running of rhexis/ Incomplete ccc	2 (2%)	0 (0%)	1 (7.69%)	1 (33.33%)	0 (0%)
Tunnel related/ Premature entry	2 (2%)	1 (1.20%)	1 (7.69%)	0 (0%)	0 (0%)
Surge	1 (1%)	0 (0%)	0 (0%)	1 (33.33%)	0 (0%)
DM detachment	1 (1%)	0 (0%)	0 (0%)	1 (33.33%)	0 (0%)
Iris prolapsed through Side port	1 (1%)	1 (1.20%)	0 (0%)	0 (0%)	0 (0%)

The next most common complication was PCR with vitreous loss which was seen in 3% cases. Posterior capsular rupture was seen in 3 (3%) cases. The rate is similar the studies conducted by Eiichi N, et al. [3], Ng DT, et al. [5] and Martin KR, et al. [9]. However the Studies by Maj Mathur V, et al. [4], Robin AL, et al. [6], and Bhagat N, et al. [8] showed higher rates (**Table – 8**).

All cases with PCR were associated with vitreous loss in our study. It compares well with the study by Bhagat N, et al. [8] and is much lower than that conducted by Maj Mathur V, et al. [4]. Two out of three cases of PCR with vitreous loss were noted during cortical wash, similar to that reported by Eiichi N, et al. [3] and one occurred during trenching. Maj Mathur V, et al. [4] in his study reported PCR during trenching (**Table – 9**). As soon as PCR was noted bridal suture was released and aspiration flow rate was reduced. Anterior chamber was filled with viscoelastic

material. The remnant cortical matter was carefully removed. Open sky vitrectomy was performed as facilities for automated vitrectomywere not available. AC IOLs were implanted in all cases.

Figure - 1: Correlation of total phaco time with intra-operative complications.



Iris incarceration in phaco probe was seen in 3% cases. Robin AL, et al. [6] reported an incidence of 4% of the same. A much higher incidence (10%) was noted by Thomas R, et al. [7] in their study. Once Iris incarceration was noticed, the foot switch was immediately moved to position 1 to release the iris. Invariably, damage to the iris at the site of incarceration was noted in all cases. Iris damage was noted in 4.2% cases in the study done by Maj Mathur V, et al. [4].

Tunnel related complications were seen in 2% cases. This included 1cases of unstable anterior chamber due to large tunnel and one case of premature entry into the anterior chamber. The height of the bottle was raised and in the case with premature entry, at the end of the surgery, the wound was closed with 10-0 silk. Eiichi N, et al. [3] reported an incidence of 1.4% of premature entry into anterior chamber. Surge occurred in one (1%) case. There was no access to air pump during surgery. The vacuum power was reduced and the procedure was continued.

Capsulorrhexis related complications were seen in 2.0% cases. This included running of capsulorrhexis in one case and incomplete CCC in one. Once the rhexis was noted to have run slightly to the periphery, it was completed from the initial nick in the opposite direction and Phacoemulsification was performed successfully. Although risky, Phacoemulsification was completed in the case in which rhexis was converted to can-opener capsulotomy, as the part that was converted was quite small rendering it relatively safe to perform Phacoemulsification. Ng DT, et al. [3] reported an incidence of 3.8% of anterior capsular tears in their study. Maj Mathur V, et al. [4] reported an incidence of 4.28% of the same in their study and it was managed by converting the procedure to extra-capsular cataract extraction (**Table – 10**). Results of our study are in agreement with above mentioned studies. Detachment of Descemet's membrane was noted in one (1%) case. The detachment probably occurred due to a slightly blunt entry blade. The blade was discarded and once was procedure was completed, the detachment was managed by

placing a single large air bubble in the anterior chamber. As the detachment was not large, no sutures were required.

Table - 7: Incidence of intra-operative complications.

Study	Percentage
Eiichi N, et al. [3]	19.3
Maj Mathur V, et al. [4]	27
Ng DT, et al. [5]	6.8
Robin AL, et al. [6]	21.3
Present study	17

Table - 8: Incidence of PC rent in our study compared to authors.

Study	Percentage
Eiichi N, et al. [3]	3.6
Ng DT, et al. [5]	2.1
Bhagat N, et al. [8]	6.7
Robin AL, et al. [6]	13.3
Maj Mathur V, et al. [4]	11.4
Martin KR, et al. [9]	1.8
Present study	3.0

Table - 9: Incidence of vitreous loss.

Study	Percentage
Martin KR, et al. [9]	1.3
Maj Mathur V, et al. [4]	11.4
Bhagat N, et al. [8]	5.4
Ng DT, et al. [5]	1.4
Present Study	**3.0**

Table - 10: Incidence of capsule related complications.

Study	Percentage
Ng DT, et al. [5]	3.8
Maj Mathur V, et al. [4]	4.28
Eiichi N, et al. [3]	8.8
Present Study	2.0

Intra-operative prolapse of the iris through the side port was noted in one (1%) case. This occurred due to a slightly large, poorly constructed side port. After the procedure was completed, iris was reposited with viscoelastic and the side port was sutured with10-0 silk. Reversible iris prolapse, not necessarily from the side port was noted in 0.6% cases by Ng DT, et al. [5], in 0.8% cases by Eiichi N, et al. [3] and in 1.4% of cases in the study done by Maj Mathur V, et al [4]. Results of our study are in agreement with above mentioned studies (**Table – 11**).

Table - 11: Incidence of intra-operative iris prolapsed.

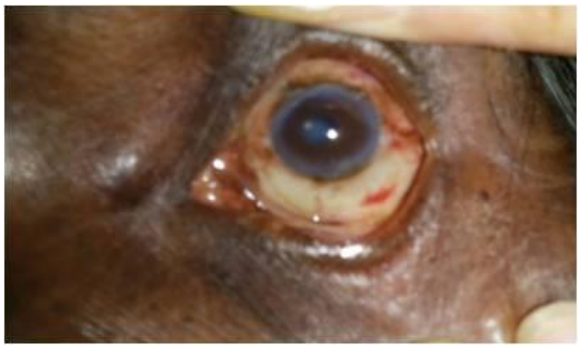
Study	Percentage
Ng DT, et al. [5]	0.6
Eiichi N, et al. [3]	0.8
Maj Mathur V, et al. [4]	1.4
Robin AL, et al. [6]	3.7
Present Study	**1.0**

Figure - 2: Complications in the Study.
Hard nucleus converted to SICS

IRIS prolapsed into side port

Running rhexis

Shallow anterior chamber intra operatively



Out of the 100 cases operated 17 (17%) were associated with complications. Incidence of complications seems to increase with increase in grade of the nuclear cataract. Nuclear cataracts grade 3 with or without PSC constituted the majority of cases with complications (35.3%) of all complications with P<0.001. A similar finding was noted by Ng DT, et al. [5] in their study.

Total Phacoemulsification time lasted less than one minute in 33% patients and more than two minutes in 4% patients. In majority of the patients (63%), phaco time lasted between one to two minutes. There was a significant association between increase in phaco time and intra-operative complications. 50% of patients in whom total phaco time lasted more than 2 minutes were associated with complications.

Post operative best corrected visual acuity although not part of the initial study design, after 6 weeks of follow up was found to be 6/9 or better in 83% of cases and was 6/12 or better in 96% of cases. All cases included in the study followed up for at least 6 weeks post operatively. The WHO guideline necessitates BCVA of 6/18 or better in at least 80% of cases and our study has been able to meet the same. In the study conducted by Maj Mathur V, et al. [4], the final visual acuity was found to be better than 6/12 in 78.6% of cases. Final visual acuity was found to be 6/12 or better in 94.8% cases in the study conducted by Thomas R, et al. [7]. This compares well with our study. This was probably because like in our study, Thomas R too excluded cases with posterior segment pathologies from their study [7].

Cases with no intra-operative complications all had final visual acuity of 6/18 or better whereas only 83% of patients who had some intra-operative complication had visual acuity of 6/18 or better. Cases with posterior capsular tears had the worst visual outcome with two out of three attaining visual acuity of 6/24 or worse. One case with PCR had BCVA of 6/60 and was probably due to cystoid macular edema.

Absence of intra-operative complications was significantly associated with post operative BCVA of 6/9 or better with P<0.001. The study under discussion was only designed to deal with the complications during surgery and not the speed of visual rehabilitation or comparison with conventional ECCE. Only uncomplicated cases were included; eyes with posterior segment pathologies were excluded. Hence, the results obtained from the study may or may not be generalized to other groups performing Phacoemulsification, although most findings were in concordance with other studies.

Conclusion

Although manual extra capsular cataract extraction including small incision cataract surgery has been instrumental in reducing the cataract load in India, there is an increasing demand for a more sophisticated technique to satisfy the ever increasing expectations of the patient. Surgeons in India too are slowly but

surely drifting towards Phacoemulsification and with time we will only see the drift become a much stronger current.

Phacoemulsification has stood the test of time and most surgeons have now come to accept it as a safe and effective procedure. Although believed to have a slightly longer learning curve, it is not something that cannot be mastered. The time has arrived for us to adapt and introduce Phacoemulsification as a routine in medical colleges and training institutes so the resident too is exposed to recent trends and can be given an opportunity to be well trained in the procedure, a under constant supervision.

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